

TOLT WATERSHED PRESCRIPTIONS

INTRODUCTION

The attached prescriptions are part of the Watershed Analysis conducted on the Tolt River Watershed, located in King County, Washington. The prescriptions address the triggering mechanisms contributing to potential cumulative impacts on public resources identified in the assessment portion of the Watershed Analysis. The prescriptions are intended for use in the Tolt River basin only.

As a result of the Watershed Analysis, future forest practices in the Tolt River basin will follow three courses of action: (1) Standard Forest Practice Rules will apply in nonsensitive areas; (2) the attached prescriptions will be used in areas of resource sensitivity; and (3) voluntary actions designed to restore or further enhance public resources may be used. This document details the latter two.

The resource assessment indicated that several historic forest practice standards and methods contributed to generating and delivering sediment into the Tolt River system. These historic practices included removal of riparian vegetation, removal of large organic debris (LOD) from streams, poor road construction and maintenance standards, extensive, adjacent clearcut harvest units, and clearcut harvest on areas prone to landslides. Time is the ultimate cure for many existing problems; however, these prescriptions are important for use with current and future forest practices to avoid negative impacts on public resources. The combination of time and proactive management across the landscape should allow the Tolt Watershed to recover from past practices.

The prescription team reviewed each Causal Mechanism Report (CMR) to develop prescriptions to control the identified triggering mechanism and to provide landowner flexibility to implement effective protective or preventive measures. Adaptive management requires flexibility to allow for changes in technology and to develop more effective preventive methods. Each prescription can stand on its own or easily interact with other prescriptions to address multiple problems. The forest practices rule on Watershed Analysis requires a "call" to either minimize or to prevent or avoid potential problems. The team interpreted the rule call for prevent or avoid to mean that actions would be taken to prevent the triggering mechanism from occurring or to avoid the activity that would trigger the problem.

The perspective adopted by the prescription team was to target a desired future condition to maintain or achieve on the landscape over time and space. The team envisioned that the prescriptions would form a living document that could be built on and improved over time. During development of the prescriptions, the assessment

Module Team Leaders or key individuals were invited to review the Causal Mechanism Reports to insure that the prescription team was interpreting and responding to the Causal Mechanism Reports with the prescriptions correctly. This iterative relationship proved to be quite valuable for developing sound, defensible prescriptions.

The prescription team assumed that there would often be overlap between various prescriptions; that one prescription could provide beneficial protection for multiple problems. Landowners, agencies, and other interested parties are expected to determine over time which combination of prescriptions provides the greatest level of protection to resources. The prescriptions envision a high degree of ongoing involvement from specialists, who will contribute most effectively to field application of prescriptions. The emphasis is on identifying and addressing site-specific conditions. This approach will ultimately provide better protection than generalized prescriptions that attempt to address a broad range of conditions.

Some prescriptions contain recommendations for voluntary actions that could be implemented concurrently with harvest activities or following harvest. There are opportunities for additional voluntary actions that will contribute to expeditious recovery of watershed conditions.

The prescription team recognized the need for supervision during the active phase of implementing prescriptions to insure that quality assurance and quality control measures are being applied. Post-activity monitoring is also important to determine the long-term effectiveness of individual prescriptions and the recovery of public resources. This on-going effort will contribute to a growing body of information that will support adaptive management. The Tolt Basin monitoring program has been distributed to the Tolt Cooperatives, with the intent of immediate implementation, with review at three and five years (more if needed). The plan includes the individual prescriptions, the prescription objectives, method of monitoring, and the appropriate measurements.

Additional, in-depth information regarding the Tolt Basin processes and public resources is available in the documentation and maps created during the Level 1 and Level 2 Watershed Analysis.

KEY TERMS

The terms "limited harvest," "voluntary prescriptions," and "fully engineered road" are used in several prescriptions. The following descriptions of the terms are provided to clearly define how the terms are to be interpreted.

Limited Harvest Mass Wasting Units

The removal of a select number of trees from areas identified as Mass Wasting Units (MWU). Resource managers will mark individual trees for removal only after an on-site verification by a qualified (meets the requirements for a Level 2 assessment in mass wasting) geotechnical person. The geotech will locate the mass wasting boundary within the proposed management unit, using the "keys" provided by the mass wasting prescriptions. The specific limited harvest parameters will be determined and documented, according to the "keys" in the mass wasting prescription.

Limited Harvest RMZ

The removal of a select number of trees from streamside areas identified in the Riparian Function prescriptions. Resource managers will mark the RMZ boundaries at the site, mark individual take trees, and provide a tree count of the RMZ. The intent is to provide for large conifer LOD recruitment over time. To encourage streambank, protection leave trees which display large root systems embedded in the bank.

Residual trees must receive less than 10% bole damage (no more than 1 ft² of cambium damage or no more than 1/3 of the bole circumference damaged) during falling and yarding.

Voluntary Prescription for Type 4, 5, and Untyped Waters

Sustainable LOD recruitment in Type 4, 5, and untyped waters will help maintain channel structure and sediment retention. This voluntary measure is part of the mass wasting, surface erosion, and water quality prescriptions.

Parameters that will be considered include:

- Bank slopes - steep banks > 20 degrees (40%)
- Bank material - bank material composed of highly erodible soils or mass wasting deposits.
- Channel structures - LOD and roots in the channel acting as sediment storage sites and creating a stair-step pattern that reduces sediment transport downstream and dissipates energy.

If these parameters are met, then trees within and immediately adjacent to Type 4, 5, and untyped waters will be left along sections of the stream channel. This voluntary action could become an explicit mitigation under the mass wasting prescription.

Fully Engineered Road

Definition:

The level of engineering that is necessary to recognize the significant elements of risk inherent in a specific site and to respond with a design, survey, and construction control measures that minimize the chance of failure:

Considerations:

Reconnaissance to:

- discern land forms,
- soil types,
- water presence,
- access alternatives.

Drainage design to:

- meet or exceed Hydraulics Code.
- size structures for 100-year event by USGS method plus allowance for site specific catastrophic events such as debris torrents.
- space cross drains to avoid ditch erosion and to disburse discharge without damage.
- consider effect of redirected cross drain water into discharge areas.
- consider concave vertical curves over fills to minimize fill volumes and to control possible overflow.
- avoid discharging road surface drainage directly into streams.

Survey:

- grade and centerline.
- right-of-way.
- slope stake.
- culverts referenced.

Earthwork:

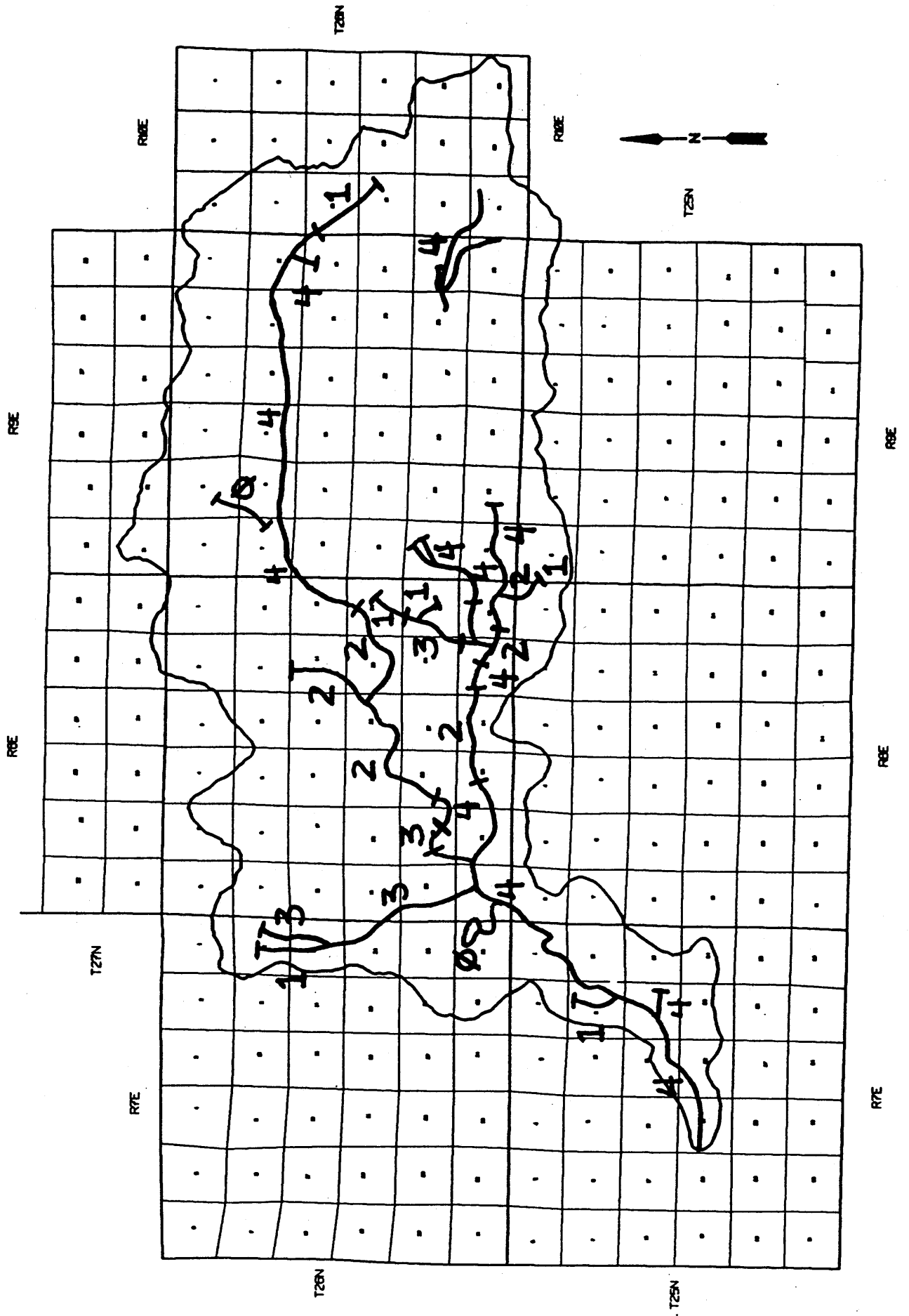
- end haul on all side slopes over 60% and other hazard areas as designated by prescription.
- place excavated material in stable location.
- utilize excavator-type construction.
- minimize disturbance.
- establish cut and fill slopes appropriate for the parent material.
- rip-rap fill slopes over 6 feet high.
- stabilize exposed soil during and after construction with appropriate methods such as: seeding, hydro-mulching, check dams, and straw.
- surface road with durable, stable material that will not contribute to surface erosion.

Supervision:

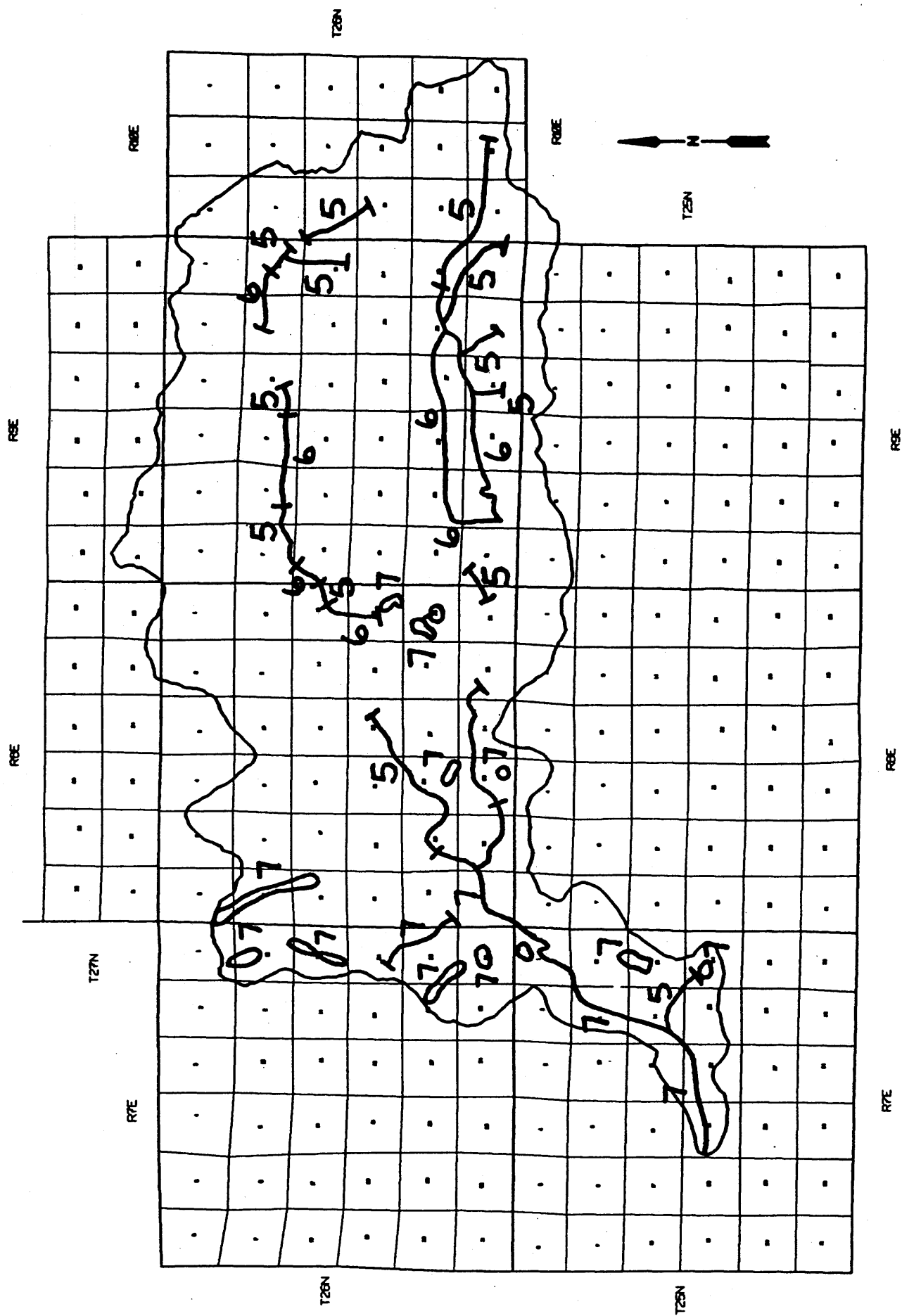
- construction will be conducted when soil conditions are optimum.
- daily control will ensure compliance with design.
- plans will become part of the forest practices application.

RIPARIAN FUNCTION

TOLT RIPARIAN LOD SITUATION



TOLT RIPARIAN SHADE HAZARD



WAU: TOLTResource Sensitivity Number: RF0 (Refer to Tolt Riparian LOD Situation Map)**Situation Sentence for the Area (from causal mechanism report):**

Harvest of Riparian trees along certain non fish-bearing (identified type 4 and 5 waters) tributaries can impair recruitment of LOD that functions to trap sediment, dissipate energy, and reduce bank erosion. Spawning and rearing habitat located downstream of these reaches are vulnerable to inputs of sediment and high energy flows that would otherwise be stored or dissipated by upstream LOD.

Triggering Mechanism (from causal mechanism report):

Harvest of riparian trees of size sufficient to function as stable LOD in these channels. Bankfull widths of these channels are typically 5m, indicating 14" diameter trees would suffice, to provide stable LOD (Bilby and Ward 1989).

Rule Call for Management Prescriptions (from causal mechanism report):
Prevent or Avoid**Field Observations:****Prescriptions:**

Apply Type 3 Forest Practice Rules to the identified Type 4 and 5 waters.

WAC 222-30-020 (3).

Justification for Prescriptions:

- Provides recruitment over time
- Provides sediment trapping for a unique situation
- Protects spawning and rearing habitat identified downstream.

WAU: TOLTResource Sensitivity Number: RF1 (Refer to Tolt Riparian LOD Situation Map)**Situation Sentence for the Area (from causal mechanism report):**

Riparian tree species within approximately 70 ft. of the channel are dominated by conifers 40-120+ years old (>12 inches dbh), or by a mixture of mature to old conifers and hardwoods. This is a situation where trees are available and are being recruited to the channel where they function to form fish habitat. Harvest of too many trees of a species and size suitable to function in the associated channel type (based on stream size, gradient, channel confinement, and channel width) will interrupt the flow of functional LOD. This results in loss of pool habitat and spawning gravel when current in-channel LOD rots or is swept away.

Triggering Mechanism (from causal mechanism report):

Harvest of trees within the riparian area without regard to their size and species relative to the type and size of the associated channel, affect the future recruitment of LOD and causes loss of wood and fish rearing habitat.

Rule Call for Management Prescriptions (from causal mechanism report):
Minimize

Field Observations: Moderate recruitment conditions and existing on target LOD conditions.

Prescriptions:

Target RMZ is 40 conifer trees per acre 30" diameter or more within 70 feet (both sides) of ordinary high water mark. Progress towards this target is evaluated by comparing existing conifer tree count against the attached Mortality Chart.

Find the leave tree count on the graph based on stand age. If surplus conifer exists, trees within the 70' RMZ (both sides) may be removed down to the Mortality Curve tree count, provided that:

- The largest conifer shall remain until the 40-30" target has been reached.
- Must replant 3 shade tolerant conifers for each surplus tree removed, or identify 3 vigorous volunteer conifer for each surplus tree removed.

- Limit Residual damage to :
 No more than 10% of the leave trees will have damage.
 With 1 sq. ft. bole damage or 1/3 circumference bole damage.
- The 70' RMZ (both sides) will be marked on site and trees marked for leave or removal by a resource manager.
- Must use 0.5% Mortality Curve. No conifer harvest allowed, except for those trees in excess of the 0.5% Mortality Curve.
- Retain hardwood to bring total tree count to standard RMZ rule requirements.

Justification for Prescriptions: Provides for sustainable, long term conifer LOD recruitment while providing an incentive for management options that will accelerate LOD recovery.

- 40 trees, adapted from Froehlich and Andrus (1988)
- 30" diameter from Bilby 1985
- 70 foot RMZ from causal Mechanism Report
- Mortality Rates from Holtman - Weyerhaeuser and other published data.
- Avoid shrub dominated riparian community (Hibbs 1989)
- Combination of LOD, shade, and channel erosion prescriptions will concentrate leave trees within 25 feet of the stream bank.

WAU: TOLTResource Sensitivity Number: RF2 (Refer to Tolt Riparian LOD Situation Map)**Situation Sentence for the Area (from causal mechanism report):**

Riparian tree species within approximately 70 ft. of the channel are dominated by conifers 40-120+ yrs old (>12 inches dbh), or by a mixture of mature to old conifers and hardwoods. The channel lacks adequate amounts of functional large organic debris (LOD). This is a situation where the riparian zone contains trees suitable for recruitment to the channel, but the channel lacks the wood needed to form fish habitat. Harvest of too many trees of a species and size suitable to function in the associated channel type (based on stream size, gradient and channel confinement) will interrupt the flow of functional LOD and delay the recovery of the channel. Further loss of pools and spawning gravel is also possible.

Triggering Mechanism (from causal mechanism report):

Riparian harvest with no regard for tree species and size or associated channel width affects future LOD recruitment. This results in loss of channel stability and fish spawning and rearing habitat.

Rule Call for Management Prescriptions (from causal mechanism report):
Prevent or Avoid

Field Observations:**Prescriptions:**

Target RMZ is 40 conifer trees per acre 30" diameter or more within 70 feet (both sides) of ordinary high water mark. Progress towards this target is evaluated by comparing existing conifer tree count against the attached Mortality Chart.

Find the leave tree count on the graph based on stand age. If surplus conifer exists, trees within the 70' RMZ (both sides) may be removed down to the Mortality Curve tree count, provided that:

- The largest conifer shall remain until the 40-30" target has been reached.
- Must replant 3 shade tolerant conifers for each surplus tree removed, or identify 3 vigorous volunteer conifer for each surplus tree removed.

Prescriptions (continued):

- **Limit Residual damage to:**
No more than 10% of the leave trees will have damage.
With 1 sq. ft. bole damage or 1/3 circumference bole damage.
- The 70' RMZ (both sides) will be marked on site and trees marked for leave or removal by a resource manager.
- Must use 1% Mortality Curve. No conifer harvest allowed, except for those trees in excess of the 1% Mortality Curve.
- Retain hardwood to bring total tree count to standard RMZ rule requirements.

Voluntary Option:

If landowner elects to work cooperatively with the affected Indian tribe and appropriate state agencies to design and implement an acceptable plan for creating effective LOD, then the RMZ is rated RF1. Monitoring will be reviewed annually and riparian function will be evaluated after five years.

Justification for Prescriptions: Provides for sustainable, long term conifer LOD recruitment while providing an incentive for management options that will accelerate LOD recovery.

- 40 trees, adapted from Froehlich and Andrus (1988)
- 30" diameter from Bilby 1985
- 70 foot RMZ from causal Mechanism Report
- Mortality Rates from Holtman - Weyerhaeuser and other published data.
- Avoid shrub dominated riparian community (Hibbs 1989)
- Combination of LOD, shade, and channel erosion prescriptions will concentrate leave trees within 25 feet of the stream bank.

WAU: TOLTResource Sensitivity Number: RF3 (Refer to Tolt Riparian LOD Situation Map)**Situation Sentence for the Area (from causal mechanism report):**

Riparian tree species within approximately 70 ft. of the channel are dominated by hardwoods, or by hardwoods mixed with young conifer, or solely by young conifer. This situation indicates that recruitable, functional wood in the riparian area is presently in short supply and what there is will be unable to sustain inputs to the stream. Harvest of trees large enough to function in the local channel type (based on stream size, gradient, channel confinement and channel width) will delay recovery of the riparian area as a supplier of LOD. Fish habitat conditions related to in-channel LOD may presently be good, but lack of recruitable LOD will someday result in loss of habitat when current in-channel LOD rots or is swept away.

Triggering Mechanism (from causal mechanism report):

Past riparian harvest without regard to their size and species relative to the type and size of the associated channel has limited future potential LOD recruitment creating potential loss of wood and fish rearing habitat.

Rule Call for Management Prescriptions (from causal mechanism report):
Prevent or Avoid**Field Observations:****Prescriptions:**

Target RMZ is 40 conifer trees per acre 30" diameter or more within 70 feet (both sides) of ordinary high water mark. Progress towards this target is evaluated by comparing existing conifer tree count against the attached Mortality Chart.

Find the leave tree count on the graph based on stand age. If surplus conifer exists, trees within the 70' RMZ (both sides) may be removed down to the Mortality Curve tree count, provided that:

- The largest conifer shall remain until the 40-30" target has been reached.
- Must replant 3 shade tolerant conifers for each surplus tree removed, or identify 3 vigorous volunteer conifer for each surplus tree removed.

- Limit Residual damage to:
 No more than 10% of the leave trees will have damage.
 With 1 sq. ft. bole damage or 1/3 circumference bole damage.
- The 70' RMZ (both sides) will be marked on site and trees marked for leave or removal by a resource manager.
- Must use 1.0% Mortality Curve. No conifer harvest allowed, except for those trees in excess of the 1.0% Mortality Curve.
- Retain hardwood to bring total tree count to standard RMZ rule requirements.

Justification for Prescriptions: Provides for sustainable, long term conifer LOD recruitment while providing an incentive for management options that will accelerate LOD recovery.

- 40 trees, adapted from Froehlich and Andrus (1988)
- 30" diameter from Bilby 1985
- 70 foot RMZ from causal Mechanism Report
- Mortality Rates from Holtman - Weyerhaeuser and other published data.
- Avoid shrub dominated riparian community (Hibbs 1989)
- Combination of LOD, shade, and channel erosion prescriptions will concentrate leave trees within 25 feet of the stream bank.

WAU: TOLTResource Sensitivity Number: RF4 (Refer to Tolt Riparian LOD Situation Map)**Situation Sentence for the Area (from causal mechanism report):**

Riparian tree species within approximately 70 ft. of the channel are dominated by hardwoods or by hardwoods mixed with young conifer, or solely by young conifer. In addition, the channel currently lacks adequate amounts of functional large organic debris (LOD). This situation indicates that recruitable, functional wood in the riparian area is presently in short supply and what there is will be unable to sustain inputs to the stream. Also, fish habitat related to in-channel LOD is diminished and the ability of the riparian area to provide new LOD before the next rotation will be poor. If hardwoods are the dominant riparian tree species, then adequate LOD supplies will be even further delayed. Harvest of trees large enough to function in the local channel type (based on stream size, gradient and channel confinement) would delay recovery of the riparian area as a supplier of LOD.

Triggering Mechanism (from causal mechanism report):

Past riparian harvest without regard to their size and species relative to the type and size of the associated channel has limited future potential LOD recruitment and past channel impacts have caused loss of wood and fish rearing habitat.

Rule Call for Management Prescriptions (from causal mechanism report):
Prevent or Avoid**Field Observations:****Prescriptions:**

Target RMZ is 40 conifer trees per acre 30" diameter or more within 70 feet (both sides) of ordinary high water mark. Progress towards this target is evaluated by comparing existing conifer tree count against the attached Mortality Chart.

Find the leave tree count on the graph based on stand age. If surplus conifer exists, trees within the 70' RMZ (both sides) may be removed down to the Mortality Curve tree count, provided that:

- The largest conifer shall remain until the 40-30" target has been reached.
- Must replant 3 shade tolerant conifers for each surplus tree removed, or identify 3 vigorous volunteer conifer for each surplus tree removed.
- Limit Residual damage to:

No more than 10% of the leave trees will have damage.

With 1 sq. ft. bole damage or 1/3 circumference bole damage.

- The 70' RMZ (both sides) will be marked on site and trees marked for leave or removal by a resource manager.
- Must use 1.5% Mortality Curve. No conifer harvest allowed, except for those trees in excess of the 1.5% Mortality Curve.
- Retain hardwood to bring total tree count to standard RMZ rule requirements.

Voluntary option:

If landowner elects to work cooperatively with the affected Indian tribe and appropriate state agencies to design and implement an acceptable plan for creating effective LOD, then the RMZ is rated RF1. Monitoring will be reviewed annually and riparian function will be evaluated after five years.

Justification for Prescriptions: Provides for sustainable, long term conifer LOD recruitment while providing an incentive for management options that will accelerate LOD recovery.

- 40 trees, adapted from Froehlich and Andrus (1988)
- 30" diameter from Bilby 1985
- 70 foot RMZ from causal Mechanism Report
- Mortality Rates from Holtman - Weyerhaeuser and other published data.
- Avoid shrub dominated riparian community (Hibbs 1989)
- Combination of LOD, shade, and channel erosion prescriptions will concentrate leave trees within 25 feet of the stream bank.

WAU: TOLTResource Sensitivity Number: RF5 (Refer to Tolt Riparian Shade Hazard Map)**Situation Sentence for the Area (from causal mechanism report):**

Past harvest of riparian trees has reduced levels of canopy closure to where stream temperatures in the adjacent channel are likely to exceed state water quality standards during warm periods of the year. Juvenile trout and salmon that rear in these areas may suffer reduced growth and survival if temperatures become too warm.

Triggering Mechanism (from causal mechanism report):

Removal of riparian vegetation that contributes to canopy closure.

Rule Call for Management Prescriptions (from causal mechanism report): Prevent or Avoid

Field Observations:**Prescriptions:**

- No shade removal from an RMZ width of 70 feet both sides.
- Voluntary shade planting is encouraged

Justification for Prescriptions:

- Maintain and provide for additional shade increase over time.

WAU: TOLTResource Sensitivity Number: RF6 (Refer to Tolt Riparian Shade Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Unnaturally wide channels have reduced the ability of streamside vegetation to provide adequate canopy closure to maintain stream temperatures within state standards. Juvenile trout and salmon that rear in these areas may suffer reduced growth and survival if temperatures become too warm.

Triggering Mechanism (from causal mechanism report):

Stream widening from excessive inputs of coarse sediment causing aggradation and bank cutting. Possibly exacerbated by weakened bank integrity resulting from past harvest of riparian trees along streambanks.

Rule Call for Management Prescriptions (from causal mechanism report): Prevent or Avoid

Field Observations:

Prescriptions:

- Identify width of main channel adjacent to proposed management activity.
- Stand at a point half of the width from ordinary high water mark.
- Take half of densitometer reading facing the bank.
- No shade removal from an RMZ width of 70 feet both sides.
- Voluntary shade planting is encouraged.

Justification for Prescriptions:

- Maintain what shade exists and provide for additional shade increase over time.
- Provide for a systematic approach for measuring shade in braided reaches.
- Stream widening due to sediment inputs are addressed in stream channel prescriptions.

WAU: TOLTResource Sensitivity Number: RF7 (Refer to Tolt Riparian Shade Hazard Map)**Situation Sentence for the Area (from causal mechanism report):**

Naturally wide channels limit the ability of streamside vegetation to provide adequate canopy closure to maintain stream temperatures within state standards. Juvenile trout and salmon that rear in these areas may suffer reduced growth and survival if temperatures become too warm.

Triggering Mechanism (from causal mechanism report):

Removal of riparian vegetation that contributes to canopy closure.

Rule Call for Management Prescriptions (from causal mechanism report): Prevent or Avoid

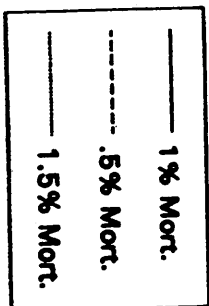
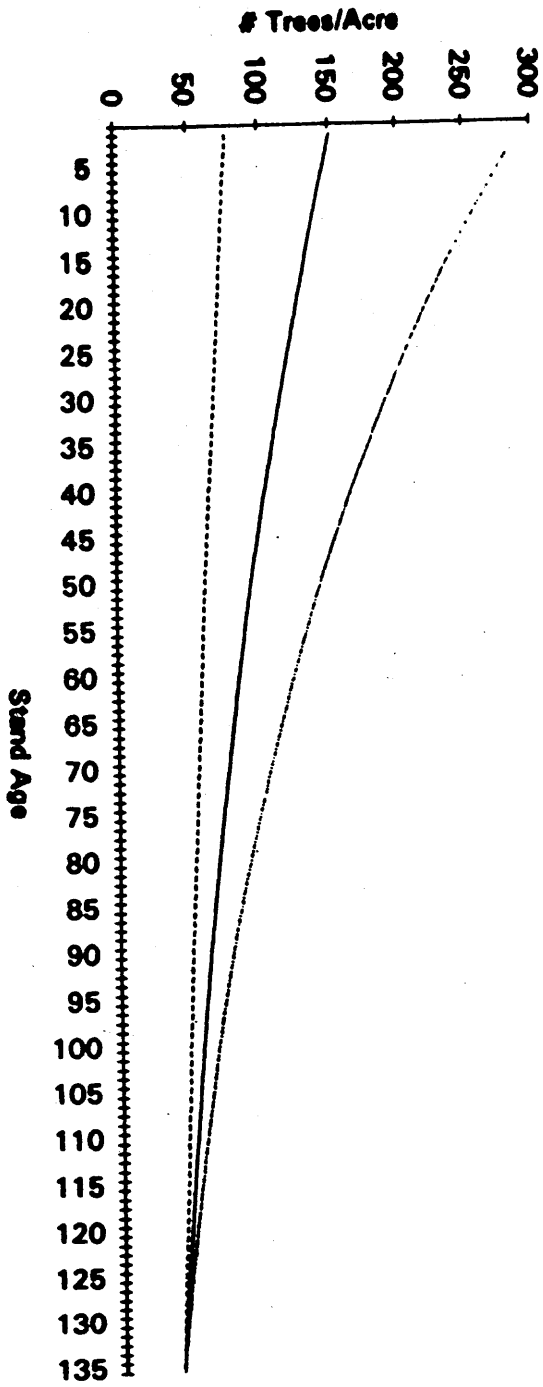
Field Observations:**Prescriptions:**

- No removal of shade.
- Voluntary shade planting is encouraged.

Justification for Prescriptions:

- Due to volume of water, the shading influence of riparian vegetation has less effect on these waters.

Required Leave to Achieve 40 Trees/Acre at Stand Age 135 for Three Assumed Mortality Rates



Leave Required to Attain 40 Trees/acre Assuming 1% Annual Mortality

Leave Required Assuming:

Age	1% Mort.	.5% Mort.	1.5% Mort.
1	152	78	294
2	150	78	290
3	148	77	286
4	147	77	281
5	146	76	277
6	144	76	273
7	143	76	269
8	142	75	266
9	140	75	261
10	139	75	257
11	137	74	253
12	136	74	250
13	135	74	246
14	133	73	242
15	132	73	239
16	131	72	236
17	129	72	232
18	128	72	228
19	127	71	225
20	126	71	222
21	124	71	218
22	123	70	215
23	122	70	212
24	121	70	209
25	120	69	206
26	118	69	203
27	117	69	200
28	116	68	197
29	115	68	194
30	114	68	191
31	113	67	188
32	111	67	185
33	110	67	183
34	109	66	180
35	108	66	177
36	107	66	175
37	106	65	172
38	105	65	170
39	104	65	167
40	103	64	165
41	102	64	162
42	101	64	160
43	100	63	157
44	99	63	155
45	98	63	153
46	97	62	151
47	96	62	148
48	95	62	146
49	94	61	144
50	93	61	142
51	92	61	140
52	91	61	138
53	90	60	136
54	90	60	134
55	89	60	132
56	88	59	130
57	87	59	128
58	86	59	126
59	85	58	124
60	84	58	122
61	84	58	120

Leaves Required to Attain 40 Trees/acre Assuming 1% Annual Mortality

62	63	66	119
63	62	67	117
64	61	67	116
65	60	67	113
66	79	66	112
67	79	66	110
68	78	66	108
69	77	66	107
70	76	66	106
71	76	66	104
72	76	66	102
73	74	64	101
74	73	64	99
75	73	64	98
76	72	64	98
77	71	63	95
78	71	63	93
79	70	63	92
80	69	63	91
81	68	62	89
82	68	62	88
83	67	62	87
84	66	62	86
85	66	61	84
86	65	61	83
87	64	61	82
88	64	61	81
89	63	60	79
90	63	60	78
91	62	60	77
92	61	60	76
93	61	49	75
94	60	49	74
95	60	49	73
96	59	49	71
97	58	48	70
98	58	48	69
99	57	48	68
100	57	48	67
101	56	47	66
102	56	47	65
103	55	47	64
104	54	47	63
105	54	46	63
106	53	46	62
107	53	46	61
108	52	46	60
109	52	46	59
110	51	45	58
111	51	45	57
112	50	45	56
113	50	45	56
114	49	44	55
115	49	44	54
116	48	44	53
117	48	44	52
118	47	44	52
119	47	43	51
120	46	43	50
121	46	43	49
122	46	43	49
123	45	42	48
124	45	42	47
125	44	42	46
126	44	42	46

Leave Required to Attain 40 Trees/acre Assuming 1% Annual Mortality

127	43	42	45
128	43	41	44
129	42	41	44
130	42	41	43
131	42	41	42
132	41	41	42
133	41	40	41
134	40	40	41
135	40	40	40

CHANNEL EROSION

33

WAU: TOLT**Resource Sensitivity Number:**

Channel Hazard Area #1 (Bank cutting areas not covered by mass wasting module.) (Refer to Tolt Channel Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Bank cutting within braided segments is contributing coarse and fine sediment to the channel, leading to continued aggravation and channel instability, both locally and in Segment 5 of the North Fork. This has resulted in degraded summer and winter rearing habitat for cutthroat (and possibly Dolly Varden and rainbow trout). Map Units 1-6 and 1-7 (from Map E-3) also contribute coarse sediment to the reservoir.

Triggering Mechanism (from causal mechanism report):

Removal of riparian vegetation has resulted in reduced root strength and accelerated bank erosion. Peak Flow events contribute to further erosion and redistribution of sediment within and between the segments. Map Units 1-1 through 1-4 appear to have downstream controls associated with ancient landslides that make them prone to deposition. The lower half of map Unit 1-6 is also influenced by the reservoir level.

Rule Call for Management Prescriptions (from causal mechanism report):
Prevent or Avoid**Field Observations:****Prescriptions:**Landowner Choice:Option #1

- No harvest within Channel Migration Zone (CMZ).
- Identify CMZ per attached Channel Migration Zone Map and local indicators.
- Leave a Type 1 water RMZ along the CMZ boundary if there is evidence of an old channel near the extreme edge of the CMZ.

Option #2

- No clear cut within CMZ.
- Thin no greater than 20'x 20' spacing within CMZ to maintain root continuity of leave trees.
- Do not remove any tree which has canopy over ordinary high water mark or within 25 feet of ordinary high water.
- Residual trees must receive no more than 10% bole damage (no more than 1 ft² of cambium damage or no more than 1/3 of the bole circumference damaged) during falling and yarding.
- Leave a Type 1 water RMZ along the CMZ boundary if there is evidence of an old channel near the extreme edge of the CMZ boundary.
- Identify CMZ per attached Channel Migration Zone Map.

Landowner will evaluate the prescription and report to the DNR in 5 years on the effectiveness of 20'x 20' spacing. The evaluation will monitor channel changes and DNR will renew, amend, or delete the prescription accordingly.

Justification for Prescriptions:

Maintains root strength for bank and channel stability and provides sustainable recruitment of LOD.

WAU: TOLT

Resource Sensitivity Number:

Channel Hazard Area #2 (This is not really a hazard area - it is important to the recovery of hazard area #1) (Refer to Tolt Channel Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Recruitment of LOD is needed for recovery of braided areas (channel hazard Unit #1) downstream of these units. Trees within these areas potentially could reach the channel through blowdown, bank cutting, or mass wasting and be transported to the braided segments of LOD.

Triggering Mechanism (from causal mechanism report):

(See channel Unit #1 report - these areas are not "hazards" per se, but are important sources of LOD required for recovery of braided areas).

Rule Call for Management Prescriptions (from causal mechanism report):
Prevent or Avoid (Riparian Harvest).

Field Observations:

Prescriptions:

Use the appropriate RMZ prescription (RF1 or RF4) for management of long term LOD in the affected area.

Justification for Prescriptions:

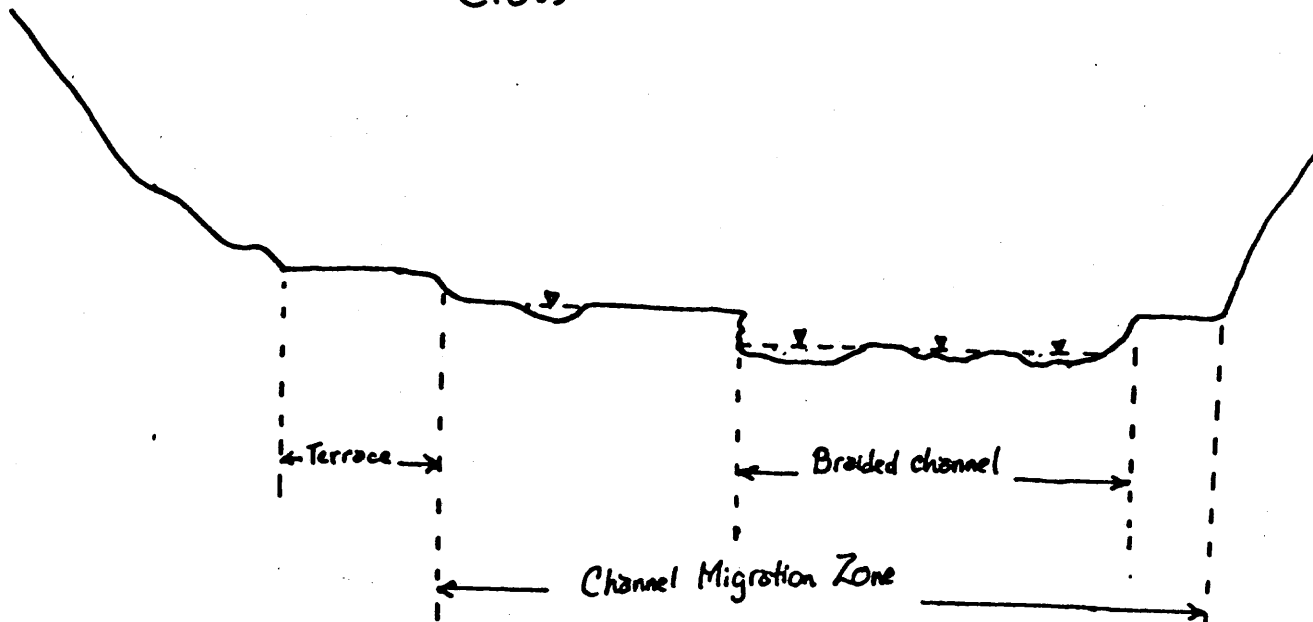
- Maintain root strength provide for long term LOD.
- Maintain root strength for stream bank stability.
- Maintain long term LOD.

TOLT RIVER WATERSHED ANALYSIS

CHANNEL MIGRATION ZONE

- the area that has been occupied by the stream channel in the recent past, plus the area that could be occupied in the future

Cross-Section



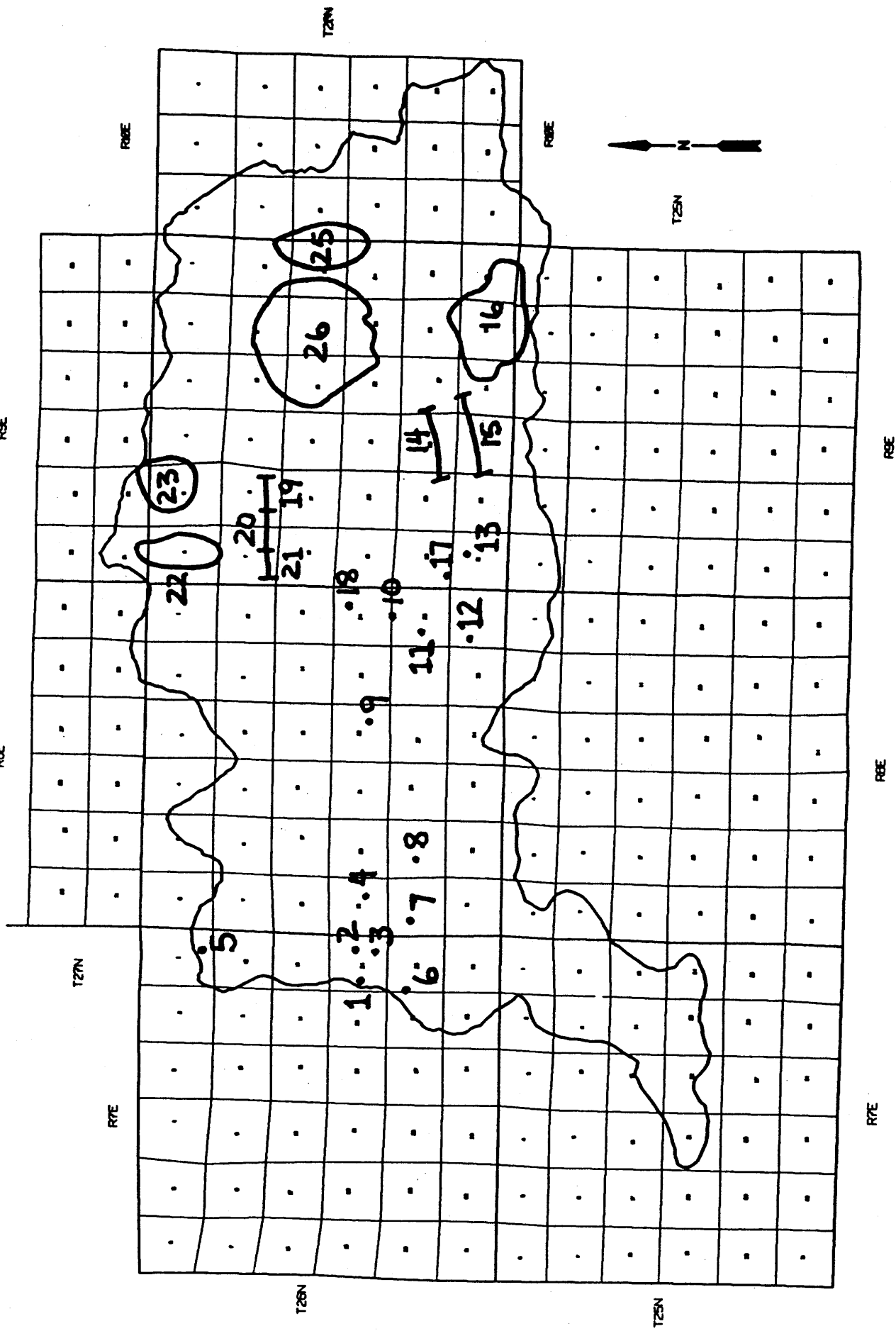
Field indicators of the channel migration zone:

- exposed alluvial deposits (rounded gravel, cobble, boulders)
- alluvial deposits covered with duff or shallow soil
- flat ground, less than 6 feet in elevation above the existing channel bank
- deciduous trees and shrubs, or conifers that are younger than the upslope forest
- wetlands and beaver ponds are common within this area

SURFACE EROSION UNITS

The following prescriptions include the development of a Road Maintenance and Operation Plan. This Plan will identify a course of action to correct sensitivities identified in the causal mechanism reports for the individual road erosion units that follow. This portion of the plan must be completed by October 1, 1993, and approved by DNR. In addition, the plan will be amended and updated to include:

- The roads associated with all new forest practices, before the forest practices applications or notifications are approved.
- Other areas of the entire basin, including the areas not covered by the causal mechanism report.



WAU: TOLTResource Sensitivity Number: Road Erosion Units 1 through 7
(Refer to Tolt Road Surface Erosion Map)**Situation Sentence for the Area (from causal mechanism report):**

Fine sediment from the pipeline mainline and Stossel Creek roads is entering Stossel Creek, which is highly vulnerable to fines. This results in reduced quality of spawning gravels and some filling of beaver ponds.

Triggering Mechanism (from causal mechanism report):

Generally, some segments of the roads lack relief culverts and others are immediately adjacent to the stream. Additionally, some culverts may not be sufficiently sized. See attached list for site-specific details. Heavy rutting on pipeline road due to traffic during rain fall and/or insufficient surfacing.

Rule Call for Management Prescriptions (from causal mechanism report):
Prevent or Avoid**Field Observations:****Prescriptions:**

- I. If sedimentation to flowing streams occurs from active truck traffic, remediate or discontinue all haul traffic until problem is corrected.
- II. Develop a Landowner Road Maintenance and Operation Plan by October 1, 1993 for approval by DNR. In addition before any FPA will be issued the landowner will amend the Plan to include all haul roads associated with that Forest Practice. Landowners will update the Road Maintenance and Operation Plan as an on going management tool.

Road maintenance and Operation Plan shall include:

1. Road Condition Survey for all active and inactive forest roads.

Inventory road related soil erosion, mass wasting and drainage information necessary to prioritize road maintenance and operation plan:

Survey shall include but not be limited to:

- Location, size and condition of drainage structures, identification of fish barriers, estimated depth of fill, road prism condition and delivery area.
- Sources of fine sediment erosion delivered directly to streams.

Evaluate these conditions:

- * Exposed fill and cutslope
 - * Ditch condition i.e.
eroding/armored/ etc.
 - * Type of use
 - * Traffic level by season
 - * Road surface material and condition
- Identify existing and potential road failures.
2. Identification and prioritization of problem areas.
 - In addition to the sensitivities identified in the assessment, the Plan will include other areas that pose potential damage to a public resource. If, while compiling the plan, the landowner identifies areas that pose an imminent threat to public resources, the landowner will promptly notify DNR and take appropriate action.
 - The Plan will prioritize activities by greatest net benefit to public resources.
 3. Implementation and completion timelines for the specific solutions and methods.
 4. Monitoring
 - Adjust priorities/timelines if conditions change, i.e., floods.
 - Include storm event inventory.
 - Landowners are encouraged to include orphaned roads in the Road Maintenance and Operations Plan.

Justification for Prescriptions:

- Develops a site specific Road Maintenance and Operation Plan, in a timely fashion, that addresses identified triggering mechanisms.
- Develops the necessary items to be included in a Road Condition Survey.
- Provides a documented and reviewed plan for problem area identification, prioritized corrective actions and ongoing monitoring of landowner's road system.
- No FPA's approved without landowner developed Road Maintenance and Operation Plan for haul roads inclusive to submitted FPA.

WAU: TOLT**Resource Sensitivity Number:**Road Erosion Units #8 & #9 (Refer to Tolt Road Surface Erosion Map)**Situation Sentence for the Area (from causal mechanism report):**

Fine sediment is eroding from the road ditch and entering the North Fork Tolt, which is tightly confined within a canyon and has a low vulnerability to fine sediment. This location is downstream of the proposed diversion. Fine sediment, however, may be routed downstream to Segment 5, which has a high vulnerability to fines.

Triggering Mechanism (from causal mechanism report):

Ditch draining the segment west of the crossing is gullied (on the mainline road). Also, the outsloped edge is bermed, allowing water to concentrate at the crossing. See segment site #6 & #3 on field form, lower North Fork.

Rule Call for Management Prescriptions (from causal mechanism report):Minimize**Field Observations:****Prescriptions:**

- I. If sedimentation to flowing streams occurs from active truck traffic, remediate or discontinue all haul traffic until problem is corrected.
- II. Develop a Landowner Road Maintenance and Operation Plan by October 1, 1993 for approval by DNR. In addition before any FPA will be issued the landowner will amend the Plan to include all haul roads associated with that Forest Practice. Landowners will update the Road Maintenance and Operation Plan as an on going management tool.

Road maintenance and Operation Plan shall include:

1. Road Condition Survey for all active and inactive forest roads.

Inventory road related soil erosion, mass wasting and drainage information necessary to prioritize road maintenance and operation plan:

Survey shall include but not be limited to:

- Location, size and condition of drainage structures, identification of fish barriers, estimated depth of fill, road prism condition and delivery area.
- Sources of fine sediment erosion delivered directly to streams.

Evaluate these conditions:

- * Exposed fill and cutslope
 - * Ditch condition i.e. eroding/armored/ etc.
 - * Type of use
 - * Traffic level by season
 - * Road surface material and condition
- Identify existing and potential road failures.
2. Identification and prioritization of problem areas.
 - In addition to the sensitivities identified in the assessment, the Plan will include other areas that pose potential damage to a public resource. If, while compiling the plan, the landowner identifies areas that pose an imminent threat to public resources, the landowner will promptly notify DNR and take appropriate action.
 - The Plan will prioritize activities by greatest net benefit to public resources.
 3. Implementation and completion timelines for the specific solutions and methods.
 4. Monitoring
 - Adjust priorities/timelines if conditions change, i.e. floods.
 - Include storm event inventory.
 - Landowners are encouraged to include orphaned roads in the Road Maintenance and Operations Plan.

Justification for Prescriptions:

- Develops a site specific Road Maintenance and Operation Plan, in a timely fashion, that addresses identified triggering mechanisms.
- Develops the necessary items to be included in a Road Condition Survey.
- Provides a documented and reviewed plan for problem area identification, prioritized corrective actions and ongoing monitoring of landowner's road system.
- No FPA's approved without landowner developed Road Maintenance and Operation Plan for haul roads inclusive to submitted FPA.

WAU: TOLT**Resource Sensitivity Number:**Road Erosion Units 10, 11 (Lynch Creek)Road Erosion Units 12, 17 & 18 (Crazy Creek)

(Refer to Tolt Road Surface Erosion Map)

Situation Sentence for the Area (from causal mechanism report):

Fine sediment is eroding from the road surface and ditch draining into Lynch Creek and Crazy Creek. Fine sediment is also being generated at a plugged culvert and at another culvert where the outlet is directing the flow into the opposite streambank on Lynch Creek. Lynch Creek is highly sensitive to fine sediment due to its low gradient. Fine sediment degrades the spawning gravel quality for resident cutthroat and reduces rearing habitat.

Triggering Mechanism (from causal mechanism report):

Lynch Creek (RE #10): One of two culverts plugged under washed out crossing and road has insufficient lift. Lynch Creek (RE #11): Culvert at crossing aimed at and eroding opposite bank.

Crazy Creek (RE #12): Grading berm is funneling surface runoff to stream.

Crazy Creek (RE #17 & #18): Lack of relief culverts.

Rule Call for Management Prescriptions (from causal mechanism report):Prevent or Avoid**Field Observations:****Prescriptions:**

- I. If sedimentation to flowing streams occurs from active truck traffic, remediate or discontinue all haul traffic until problem is corrected.
- II. Develop a Landowner Road Maintenance and Operation Plan by October 1, 1993 for approval by DNR. In addition before any FPA will be issued the landowner will amend the Plan to include all haul roads associated with that Forest Practice. Landowners will update the Road Maintenance and Operation Plan as an on going management tool.

Road maintenance and Operation Plan shall include:

1. Road Condition Survey for all active and inactive forest roads.

Inventory road related soil erosion, mass wasting and drainage information necessary to prioritize road maintenance and operation plan:

Survey shall include but not be limited to:

- Location, size and condition of drainage structures, identification of fish barriers, estimated depth of fill, road prism condition and delivery area.
- Sources of fine sediment erosion delivered directly to streams.

Evaluate these conditions:

- * Exposed fill and cutslope
 - * Ditch condition i.e. eroding/armored/ etc.
 - * Type of use
 - * Traffic level by season
 - * Road surface material and condition
- Identify existing and potential road failures.
2. Identification and prioritization of problem areas.
 - In addition to the sensitivities identified in the assessment, the Plan will include other areas that pose potential damage to a public resource. If, while compiling the plan, the landowner identifies areas that pose an imminent threat to public resources, the landowner will promptly notify DNR and take appropriate action.
 - The Plan will prioritize activities by greatest net benefit to public resources.
 3. Implementation and completion timelines for the specific solutions and methods.
 4. Monitoring
 - Adjust priorities/timelines if conditions change, i.e. floods.
 - Include storm event inventory.
 - Landowners are encouraged to include orphaned roads in the Road Maintenance and Operations Plan.

Justification for Prescriptions:

- Develops a site specific Road Maintenance and Operation Plan, in a timely fashion, that addresses identified triggering mechanisms.
- Develops the necessary items to be included in a Road Condition Survey.
- Provides a documented and reviewed plan for problem area identification, prioritized corrective actions and ongoing monitoring of landowner's road system.
- No FPA's approved without landowner developed Road Maintenance and Operation Plan for haul roads inclusive to submitted FPA.

WAU: TOLT

Resource Sensitivity Number: Road Erosion Units 14, 15, 16
(Refer to Tolt Road Surface Erosion Map)

Situation Sentence for the Area (from causal mechanism report):
Fine sediment from roads adjacent to and on hillslopes above the South Fork Tolt reservoir is increasing turbidity and lowering water quality to a highly vulnerable resource.

Triggering Mechanism (from causal mechanism report):
Roads adjacent to the shoreline have direct entry and other roads are constructed on easily eroded native material. Unvegetated cut and fill slopes also are major sediment contributors. See attached list for more details. Maintenance activities and traffic on 50 Road. Concentrated runoff from roads and intercepted groundwater and overland flow.

Rule Call for Management Prescriptions (from causal mechanism report):
Prevent or Avoid (pending road inventory)

Field Observations:**Prescriptions:**

- I. If sedimentation to flowing streams occurs from active truck traffic, remediate or discontinue all haul traffic until problem is corrected.
- II. Develop a Landowner Road Maintenance and Operation Plan by October 1, 1993 for approval by DNR. In addition before any FPA will be issued the landowner will amend the Plan to include all haul roads associated with that Forest Practice. Landowners will update the Road Maintenance and Operation Plan as an on going management tool.

Road maintenance and Operation Plan shall include:

1. Road Condition Survey all active and inactive forest roads.

Inventory road related soil erosion, mass wasting and drainage information necessary to prioritize road maintenance and operation plan:

Survey shall include but not be limited to:

- Location, size and condition of drainage structures, identification of fish barriers, estimated depth of fill, road prism condition and delivery area.
- Sources of fine sediment erosion delivered directly to streams.

Evaluate these conditions:

- * Exposed fill and cutslope
- * Ditch condition i.e.
eroding/armored/ etc.
- * Type of use
- * Traffic level by season
- * Road surface material and condition

- Identify existing and potential road failures.
2. Identification and prioritization of problem areas.
- In addition to the sensitivities identified in the assessment, the Plan will include other areas that pose potential damage to a public resource. If, while compiling the plan, the landowner identifies areas that pose an imminent threat to public resources, the landowner will promptly notify DNR and take appropriate action.
 - The Plan will prioritize activities by greatest net benefit to public resources.
3. Implementation and completion timelines for the specific solutions and methods.
4. Monitoring
- Adjust priorities/timelines if conditions change, i.e. floods.
 - Include storm event inventory.
 - Landowners are encouraged to include orphaned roads in the Road Maintenance and Operations Plan.

Justification for Prescriptions:

- Develops a site specific Road Maintenance and Operation Plan, in a timely fashion, that addresses identified triggering mechanisms.
- Develops the necessary items to be included in a Road Condition Survey.
- Provides a documented and reviewed plan for problem area identification, prioritized corrective actions and ongoing monitoring of landowner's road system.
- No FPA's approved without landowner developed Road Maintenance and Operation Plan for haul roads inclusive to submitted FPA.

WAU: TOLT**Resource Sensitivity Number:**Road Erosion Units #19 (Refer to Tolt Road Surface Erosion Map)**Situation Sentence for the Area (from causal mechanism report):**

Fine sediment and road drainage on the mainline road paralleling the North Fork Tolt could contribute to turbidity of proposed diversion waters. Fines may also affect resident trout spawning areas in 11, 12a, 12b, 13, and 14 (See map below).

Triggering Mechanism (from causal mechanism report):

Active bank erosion on the north side of the river is creating bank instability where the road parallels the stream. Field form site #6 has high direct entry potential and possibly contributes to downstream bank erosion near the mouth of a small tributary stream due to increased runoff.

Rule Call for Management Prescriptions (from causal mechanism report):

Prevent or Avoid (due to high vulnerability of proposed public water supply)

Field Observations:**Prescriptions:**

- I. If sedimentation to flowing streams occurs from active truck traffic, remediate or discontinue all haul traffic until problem is corrected.
- II. Develop a Landowner Road Maintenance and Operation Plan by October 1, 1993 for approval by DNR. In addition before any FPA will be issued the landowner will amend the Plan to include all haul roads associated with that Forest Practice. Landowners will update the Road Maintenance and Operation Plan as an on going management tool.

Road maintenance and Operation Plan shall include:

1. Road Condition Survey for all active and inactive forest roads.

Inventory road related soil erosion, mass wasting and drainage information necessary to prioritize road maintenance and operation plan:

Survey shall include but not be limited to:

- Location, size and condition of drainage structures, identification of fish barriers, estimated depth of fill, road prism condition and delivery area.
- Sources of fine sediment erosion delivered directly to streams.

Evaluate these conditions:

- * Exposed fill and cutslope
- * Ditch condition i.e.
eroding/armored/ etc.
- * Type of use
- * Traffic level by season
- * Road surface material and condition

- Identify existing and potential road failures.
2. Identification and prioritization of problem areas.
- In addition to the sensitivities identified in the assessment, the Plan will include other areas that pose potential damage to a public resource. If, while compiling the plan, the landowner identifies areas that pose an imminent threat to public resources, the landowner will promptly notify DNR and take appropriate action.
 - The Plan will prioritize activities by greatest net benefit to public resources.
3. Implementation and completion timelines for the specific solutions and methods.
4. Monitoring
- Adjust priorities/timelines if conditions change, i.e. floods.
 - Include storm event inventory.
 - Landowners are encouraged to include orphaned roads in the Road Maintenance and Operations Plan.

Justification for Prescriptions:

- Develops a site specific Road Maintenance and Operation Plan, in a timely fashion, that addresses identified triggering mechanisms.
- Develops the necessary items to be included in a Road Condition Survey.
- Provides a documented and reviewed plan for problem area identification, prioritized corrective actions and ongoing monitoring of landowner's road system.
- No FPA's approved without landowner developed Road Maintenance and Operation Plan for haul roads inclusive to submitted FPA.

WAU: TOLT

Resource Sensitivity Number: Road Erosion Units 20,21,22,23
(Refer to Tolt Road Surface Erosion Map)

Situation Sentence for the Area (from causal mechanism report):
Fine sediment is eroding from roads in the North Fork Basin between Yellow Creek and Dry Creek can reach Segments 11, 12a, 12b, 13, 14, and parts of associated tributaries, which generally have a high vulnerability to fines. This may cause localized reduction in pool habitat and degradation of spawning gravel for resident trout.

Triggering Mechanism (from causal mechanism report):
Fines are generated from fill failures, unvegetated cut and fill slopes and road-initiated failure scars. See attached list for details.

Rule Call for Management Prescriptions (from causal mechanism report):
Prevent or Avoid (pending road inventory)

Field Observations:**Prescriptions:**

- I. If sedimentation to flowing streams occurs from active truck traffic, remediate or discontinue all haul traffic until problem is corrected.
- II. Develop a Landowner Road Maintenance and Operation Plan by October 1, 1993 for approval by DNR. In addition before any FPA will be issued the landowner will amend the Plan to include all haul roads associated with that Forest Practice. Landowners will update the Road Maintenance and Operation Plan as an on going management tool.

Road maintenance and Operation Plan shall include:

1. Road Condition Survey for all active and inactive forest roads.

Inventory road related soil erosion, mass wasting and drainage information necessary to prioritize road maintenance and operation plan:

Survey shall include but not be limited to:

- Location, size and condition of drainage structures, identification of fish barriers, estimated depth of fill, road prism condition and delivery area.
- Sources of fine sediment erosion delivered directly to streams.

Evaluate these conditions:

- * Exposed fill and cutslope
- * Ditch condition i.e.
eroding/armored/ etc.
- * Type of use
- * Traffic level by season
- * Road surface material and condition

- Identify existing and potential road failures.

2. Identification and prioritization of problem areas.

- In addition to the sensitivities identified in the assessment, the Plan will include other areas that pose potential damage to a public resource. If, while compiling the plan, the landowner identifies areas that pose an imminent threat to public resources, the landowner will promptly notify DNR and take appropriate action.
- The Plan will prioritize activities by greatest net benefit to public resources.

3. Implementation and completion timelines for the specific solutions and methods.

4. Monitoring

- Adjust priorities/timelines if conditions change, i.e. floods.
- Include storm event inventory.
- Landowners are encouraged to include orphaned roads in the Road Maintenance and Operations Plan.

Justification for Prescriptions:

- Develops a site specific Road Maintenance and Operation Plan, in a timely fashion, that addresses identified triggering mechanisms.
- Develops the necessary items to be included in a Road Condition Survey.
- Provides a documented and reviewed plan for problem area identification, prioritized corrective actions and ongoing monitoring of landowner's road system.
- No FPA's approved without landowner developed Road Maintenance and Operation Plan for haul roads inclusive to submitted FPA.

WAU: TOLT

Resource Sensitivity Number: Road Erosion Units 24, 25, 26
(Refer to Tolt Road Surface Erosion Map)

Situation Sentence for the Area (from causal mechanism report):
Fine sediment is eroding from steep gradient roads and associated cut and fill slopes in areas of the North Fork Basin above Dry Creek are reaching the tributaries and North Fork Tolt, increasing turbidity and lowering water quality downstream.

Triggering Mechanism (from causal mechanism report):
Natural soil erodibility along with steep gradients and unvegetated cut and fill slopes are contributing to chronic sediment production. See attached list for details.

Rule Call for Management Prescriptions (from causal mechanism report):
Prevent or Avoid

Field Observations:

Prescriptions:

- I. If sedimentation to flowing streams occurs from active truck traffic, remediate or discontinue all haul traffic until problem is corrected.
- II. Develop a Landowner Road Maintenance and Operation Plan by October 1, 1993 for approval by DNR. In addition before any FPA will be issued the landowner will amend the Plan to include all haul roads associated with that Forest Practice. Landowners will update the Road Maintenance and Operation Plan as an on going management tool.

Road maintenance and Operation Plan shall include:

1. Road Condition Survey for all active and inactive forest roads.

Inventory road related soil erosion, mass wasting and drainage information necessary to prioritize road maintenance and operation plan:

Survey shall include but not be limited to:

- Location, size and condition of drainage structures, identification of fish barriers, estimated depth of fill, road prism condition and delivery area.
- Sources of fine sediment erosion delivered directly to streams.

Evaluate these conditions:

- * Exposed fill and cutslope
- * Ditch condition i.e.
eroding/armored/ etc.
- * Type of use
- * Traffic level by season
- * Road surface material and condition

- Identify existing and potential road failures.

2. Identification and prioritization of problem areas.

- In addition to the sensitivities identified in the assessment, the Plan will include other areas that pose potential damage to a public resource. If, while compiling the plan, the landowner identifies areas that pose an imminent threat to public resources, the landowner will promptly notify DNR and take appropriate action.
- The Plan will prioritize activities by greatest net benefit to public resources.

3. Implementation and completion timelines for the specific solutions and methods.

4. Monitoring

- Adjust priorities/timelines if conditions change, i.e. floods.
- Include storm event inventory.
- Landowners are encouraged to include orphaned roads in the Road Maintenance and Operations Plan.

Justification for Prescriptions:

- Develops a site specific Road Maintenance and Operation Plan, in a timely fashion, that addresses identified triggering mechanisms.
- Develops the necessary items to be included in a Road Condition Survey.
- Provides a documented and reviewed plan for problem area identification, prioritized corrective actions and ongoing monitoring of landowner's road system.
- No FPA's approved without landowner developed Road Maintenance and Operation Plan for haul roads inclusive to submitted FPA.

WAU: TOLT

Resource Sensitivity Number:

Road Erosion Units 13 (Lower South Fork)
(Refer to Tolt Road Surface Erosion Map)

Situation Sentence for the Area (from causal mechanism report):
Fine sediment is eroding from gully along T70 mainline road.

Triggering Mechanism (from causal mechanism report):
Gullying on road and ditch due to lack of relief culverts.

Rule Call for Management Prescriptions (from causal mechanism report):
Minimize

Field Observations:

Prescriptions:

- I. If sedimentation to flowing streams occurs from active truck traffic, remediate or discontinue all haul traffic until problem is corrected.
- II. Develop a Landowner Road Maintenance and Operation Plan by October 1, 1993 for approval by DNR. In addition before any FPA will be issued the landowner will amend the Plan to include all haul roads associated with that Forest Practice. Landowners will update the Road Maintenance and Operation Plan as an on going management tool.

Road maintenance and Operation Plan shall include:

1. Road Condition Survey for all active and inactive forest roads.

Inventory road related soil erosion, mass wasting and drainage information necessary to prioritize road maintenance and operation plan:

Survey shall include but not be limited to:

- Location, size and condition of drainage structures, identification of fish barriers, estimated depth of fill, road prism condition and delivery area.
- Sources of fine sediment erosion delivered directly to streams.

Evaluate these conditions:

- * Exposed fill and cutslope
- * Ditch condition i.e.
eroding/armored/ etc.
- * Type of use
- * Traffic level by season
- * Road surface material and condition

- Identify existing and potential road failures.

2. Identification and prioritization of problem areas.

- In addition to the sensitivities identified in the assessment, the Plan will include other areas that pose potential damage to a public resource. If, while compiling the plan, the landowner identifies areas that pose an imminent threat to public resources, the landowner will promptly notify DNR and take appropriate action.
- The Plan will prioritize activities by greatest net benefit to public resources.

3. Implementation and completion timelines for the specific solutions and methods.

4. Monitoring

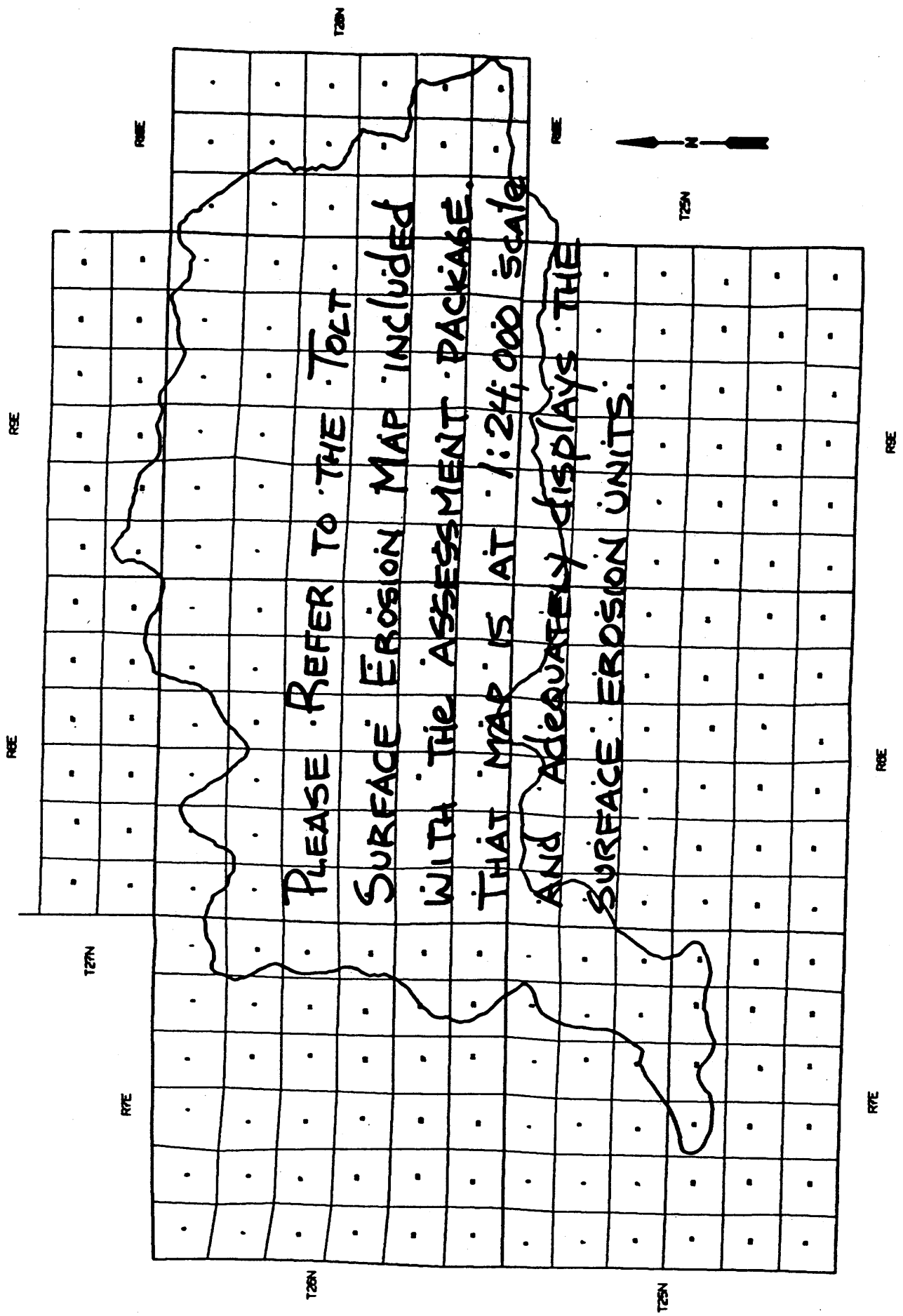
- Adjust priorities/timelines if conditions change, i.e. floods.
- Include storm event inventory.
- Landowners are encouraged to include orphaned roads in the Road Maintenance and Operations Plan.

Justification for Prescriptions:

- Develops a site specific Road Maintenance and Operation Plan, in a timely fashion, that addresses identified triggering mechanisms.
- Develops the necessary items to be included in a Road Condition Survey.
- Provides a documented and reviewed plan for problem area identification, prioritized corrective actions and ongoing monitoring of landowner's road system.
- No FPA's approved without landowner developed Road Maintenance and Operation Plan for haul roads inclusive to submitted FPA.

SURFACE EROSION UNITS

TOLT SURFACE EROSION



WAU: TOLTResource Sensitivity Number: Surface Erosion Map Unit 1
(Refer to Tolt Surface Erosion Map)**Situation Sentence for the Area (from causal mechanism report):**

Fine sediment from the steep terrace risers in the lowlands, where they occur adjacent to streams, can be delivered to the stream system when soils are disturbed, resulting in pool filling and turbidity. Coarse sediment could be delivered from sites immediately adjacent to the stream.

Triggering Mechanism (from causal mechanism report):

Activities that disturb the forest floor affect the ability of the soil to absorb water and to trap erosion products. Where this disturbance extends to the stream, erosion products from the hillside are introduced into the stream system. Dragging logs across the stream, or dragging them from the banks of streams cause this type of disturbance. Operating a skidder in or very near the stream also causes this type of disturbance. Excessive soil disturbance on these slopes increases the chances of providing a route for delivery of fine sediment to the stream system.

Rule Call for Management Prescriptions (from causal mechanism report):
Minimize**Field Observations:****Prescriptions:**

- Within the ordinary high water mark maintain stream channel structure, by minimizing soil disturbance, exposure, and compaction. Landowner will evaluate most effective strategy for protection.

- Type 4 waters subject to HPA where applicable
- Types 5's waters and non HPA Type 4's

Where practical landowner will:

- * Fall and Yard away from creek
 - * Minimize disturbance of understory vegetation
 - * Retain non-merchantable trees
 - * Avoid altering surface or sub surface drainage (i.e. swales, springs) when operating equipment or yarding logs.
 - * Identify stable locations for designated temporary stream crossings.
- No soil exposure or compaction within

<u>Slope</u>		<u>Horizontal distance</u>
≥40%	=	100'
5-39%	=	50'
0- 4%	=	25'

* If disturbance occurs, exposed soil will be treated promptly with appropriate surface erosion technique, i.e.

- Mulching
- Seeding
- Waterbars
- Other
- Ripping
- Obstructions

Voluntary Prescription:

Landowner may elect to work cooperatively with affected Indian tribes and appropriate state agencies to evaluate the need and opportunity for sustained LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

- Minimizes disturbances that cause fine sediment erosion in Type 4 and 5 stream channels.
- Minimizes disturbances that cause fine sediment erosion near Type 4 and 5 waters.
- Minimizes disturbance on sensitive sub-surface drainage areas.
- Slope/Horizontal, soil exposure/compaction distances, from King County Surface Water Management.
- Protects exposed mineral soil from delivery to streams. Protective covers such as duff and mulch help prevent particle detachment. In areas of compacted soils and concentrated runoff, Megahan has found that obstructions such as rocks and slash are most effective in trapping sediment impounded by surface flow.

WAU: TOLTResource Sensitivity Number: Surface Erosion Map Unit 2
(Refer to Tolt Surface Erosion Map)**Situation Sentence for the Area (from causal mechanism report):**

Fine sediment from the moderate slopes adjacent to streams in the lowlands can be delivered to the stream system when soils are disturbed, resulting in pool filling and turbidity. Coarse sediment could be delivered from sites immediately adjacent to the stream.

Triggering Mechanism (from causal mechanism report):

Activities that disturb the forest floor affect the ability of the soil to absorb water and to trap erosion products. Where this disturbance extends to the stream, erosion products from the hillside are introduced into the stream system. Dragging logs across the stream, or dragging them from the banks of streams cause this type of disturbance. Operating a skidder in or very near the stream also causes this type of disturbance. Excessive soil disturbance on these slopes increases the chances of providing a route for delivery of fine sediment to the stream system.

Rule Call for Management Prescriptions (from causal mechanism report):
Minimize**Field Observations:****Prescriptions:**

- Within the ordinary high water mark maintain stream channel structure, by minimizing soil disturbance, exposure, and compaction. Landowner will evaluate most effective strategy for protection.

- Type 4 waters subject to HPA where applicable
- Types 5's waters and non HPA Type 4's

Where practical landowner will:

- * Fall and Yard away from creek
 - * Minimize disturbance of understory vegetation
 - * Retain non-merchantable trees
 - * Avoid altering surface or sub surface drainage (i.e. swales, springs) when operating equipment or yarding logs.
 - * Identify stable locations for designated temporary stream crossings.
- No soil exposure or compaction within

<u>Slope</u>		<u>Horizontal distance</u>
≥ 40%	=	100'
5-39%	=	50'
0- 4%	=	25'

- * If disturbance occurs, exposed soil will be treated promptly with appropriate surface erosion technique, i.e.

- | | |
|-------------|----------------|
| - Mulching | - Ripping |
| - Seeding | - Obstructions |
| - Waterbars | |
| - Other | |

Voluntary Prescription:

Landowner may elect to work cooperatively with affected Indian tribes and appropriate state agencies to evaluate the need and opportunity for sustained LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

- Minimizes disturbances that cause fine sediment erosion in Type 4 and 5 stream channels.
- Minimizes disturbances that cause fine sediment erosion near Type 4 and 5 waters.
- Minimizes disturbance on sensitive sub-surface drainage areas.
- Slope/Horizontal, soil exposure/compaction distances, from King County Surface Water Management.
- Protects exposed mineral soil from delivery to streams. Protective covers such as duff and mulch help prevent particle detachment. In areas of compacted soils and concentrated runoff, Megahan has found that obstructions such as rocks and slash are most effective in trapping sediment impounded by surface flow.

WAU: TOLTResource Sensitivity Number: Surface Erosion Map Unit 3
(Refer to Tolt Surface Erosion Map)**Situation Sentence for the Area (from causal mechanism report):**

Fine sediment from the steep slopes adjacent to streams in the highlands, can be delivered to the stream system when soils are disturbed, resulting in pool filling and turbidity. Coarse sediment could be delivered from sites immediately adjacent to the stream.

Triggering Mechanism (from causal mechanism report):

Activities that disturb the forest floor affect the ability of the soil to absorb water and to trap erosion products. Where this disturbance extends to the stream, erosion products from the hillside are introduced into the stream system. Dragging logs across the stream, or dragging them from the banks of streams cause this type of disturbance. Operating a skidder in or very near the stream also causes this type of disturbance. Excessive soil disturbance on these slopes increases the chances of providing a route for delivery of fine sediment to the stream system.

Rule Call for Management Prescriptions (from causal mechanism report):Minimize**Field Observations:****Prescriptions:**

- Within the ordinary high water mark maintain stream channel structure, by minimizing soil disturbance, exposure, and compaction. Landowner will evaluate most effective strategy for protection.
- Type 4 waters subject to HPA where applicable
- Types 5's waters and non HPA Type 4's

Where practical landowner will:

- * Fall and Yard away from creek
 - * Minimize disturbance of understory vegetation
 - * Retain non-merchantable trees
 - * Avoid altering surface or sub surface drainage (i.e. swales, springs) when operating equipment or yarding logs.
 - * Identify stable locations for designated temporary stream crossings.
- No soil exposure or compaction within

<u>Slope</u>		<u>Horizontal distance</u>
≥ 40%	=	100'
5-39%	=	50'
0- 4%	=	25'

* If disturbance occurs exposed soil will be treated promptly with appropriate surface erosion technique, i.e.

- | | |
|-------------|----------------|
| - Mulching | - Ripping |
| - Seeding | - Obstructions |
| - Waterbars | |
| - Other | |

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustained LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

- Minimizes disturbances that cause fine sediment erosion in Type 4 and 5 stream channels.
- Minimizes disturbances that cause fine sediment erosion near Type 4 and 5 waters.
- Minimizes disturbance on sensitive sub-surface drainage areas.
- Slope/Horizontal, soil exposure/compaction distances, from King County Surface Water Management.
- Protects exposed mineral soil from delivery to streams. Protective covers such as duff and mulch help prevent particle detachment. In areas of compacted soils and concentrated runoff, Walt Megahan has found through his work that obstructions such as rocks and slash are most effective in trapping sediment impounded by surface flow.

WAU: TOLT

Resource Sensitivity Number: Surface Erosion Map Unit 4
(Refer to Tolt Surface Erosion Map)

Situation Sentence for the Area (from causal mechanism report):

Fine sediment from the moderate to steep slopes adjacent to streams, can be delivered to the stream system when soils are disturbed, resulting in pool filling and turbidity. Coarse sediment could be delivered from sites immediately adjacent to the stream.

Triggering Mechanism (from causal mechanism report):

Activities that disturb the forest floor affect the ability of the soil to absorb water and to trap erosion products. Where this disturbance extends to the stream, erosion products from the hillside are introduced into the stream system. Dragging logs across the stream, or dragging them from the banks of streams cause this type of disturbance. Operating a skidder in or very near the stream also causes this type of disturbance. Excessive soil disturbance on these slopes increases the chances of providing a route for delivery of fine sediment to the stream system.

Rule Call for Management Prescriptions (from causal mechanism report):
Minimize**Field Observations:****Prescriptions:**

- Within the ordinary high water mark maintain stream channel structure, by minimizing soil disturbance, exposure, and compaction. Landowner will evaluate most effective strategy for protection.
- Type 4 waters subject to HPA where applicable
- Types 5's waters and non HPA Type 4's

Where practical landowner will:

- * Fall and Yard away from creek
 - * Minimize disturbance of understory vegetation
 - * Retain non-merchantable trees
 - * Avoid altering surface or sub surface drainage (i.e. swales, springs) when operating equipment or yarding logs.
 - * Identify stable locations for designated temporary stream crossings.
- No soil exposure or compaction within

<u>Slope</u>		<u>Horizontal distance</u>
≥ 40%	=	100'
5 - 39%	=	50'
0 - 4%	=	25'

* If disturbance occurs, exposed soil will be treated promptly with appropriate surface erosion technique, i.e.

- | | |
|-------------|----------------|
| - Mulching | - Ripping |
| - Seeding | - Obstructions |
| - Waterbars | |
| - Other | |

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustained LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

- Minimizes disturbances that cause fine sediment erosion in Type 4 and 5 stream channels.
- Minimizes disturbances that cause fine sediment erosion near Type 4 and 5 waters.
- Minimizes disturbance on sensitive sub-surface drainage areas.
- Slope/Horizontal, soil exposure/compaction distances, from King County Surface Water Management.
- Protects exposed mineral soil from delivery to streams. Protective covers such as duff and mulch help prevent particle detachment. In areas of compacted soils and concentrated runoff, Meghan has found that obstructions such as rocks and slash are most effective in trapping sediment impounded by surface flow.

WAU: TOLTResource Sensitivity Number: Surface Erosion Map Unit 5
(Refer to Tolt Surface Erosion Map)**Situation Sentence for the Area (from causal mechanism report):**

Fine sediment from disturbance of the alpine glacial deposits in the upper river valleys, where they occur adjacent to streams, can be delivered to the stream system when soils are disturbed, resulting in pool filling and turbidity. Coarse sediment could be delivered from sites immediately adjacent to the stream.

Fine and coarse sediment from disturbance of the alpine glacial deposits in the upper river valleys, where they occur adjacent to streams, can be delivered to the stream system when soils are disturbed, resulting in pool filling and turbidity.

Triggering Mechanism (from causal mechanism report):

Activities that disturb the forest floor affect the ability of the soil to absorb water and to trap erosion products. Where this disturbance extends to the stream, erosion products from the hillside are introduced into the stream system. These soils transport a lot of water due to their slope position, and where that water reaches the surface, it facilitates carrying erosion products to the stream system. Dragging logs across streams or seeps, or dragging them from the banks of streams cause the type of disturbance that introduces sediment to the stream system. Operating a skidder in or very near streams or seeps also causes this type of disturbance. Excessive soil disturbance on these slopes increase the chances to provide a route for delivery of fine sediment to the stream system.

Because of their location low on the slopes, large quantities of water are transported across and through the soils in this map unit. Inadequate number and size or placement of culverts can cause the heavy flow to widen an existing channel or create a new channel because the flow has been dammed or directed towards the channel walls. Channels are especially vulnerable to disturbance of the banks in this map unit.

Rule Call for Management Prescriptions (from causal mechanism report):
Minimize**Field Observations:****Prescriptions:**

- Within the ordinary high water mark maintain stream channel structure, by minimizing soil disturbance, exposure, and compaction. Landowner will evaluate most effective strategy for protection.

- Type 4 waters subject to HPA where applicable
- Types 5's waters and non HPA Type 4's

Where practical landowners will:

- * Fall and Yard away from creek
- * Minimize disturbance of understory vegetation
- * Retain non-merchantable trees
- * Avoid altering surface or sub surface drainage (i.e. swales, springs) when operating equipment or yarding logs.
- * Identify stable locations for designated temporary stream crossings.

- No soil exposure or compaction within

<u>Slope</u>		<u>Horizontal distance</u>
≥ 40%	=	100'
5-39%	=	50'
0- 4%	=	25'

- * If disturbance occurs exposed soil will be treated promptly with appropriate surface erosion technique, i.e.

- | | |
|-------------|----------------|
| - Mulching | - Ripping |
| - Seeding | - Obstructions |
| - Waterbars | |
| - Other | |

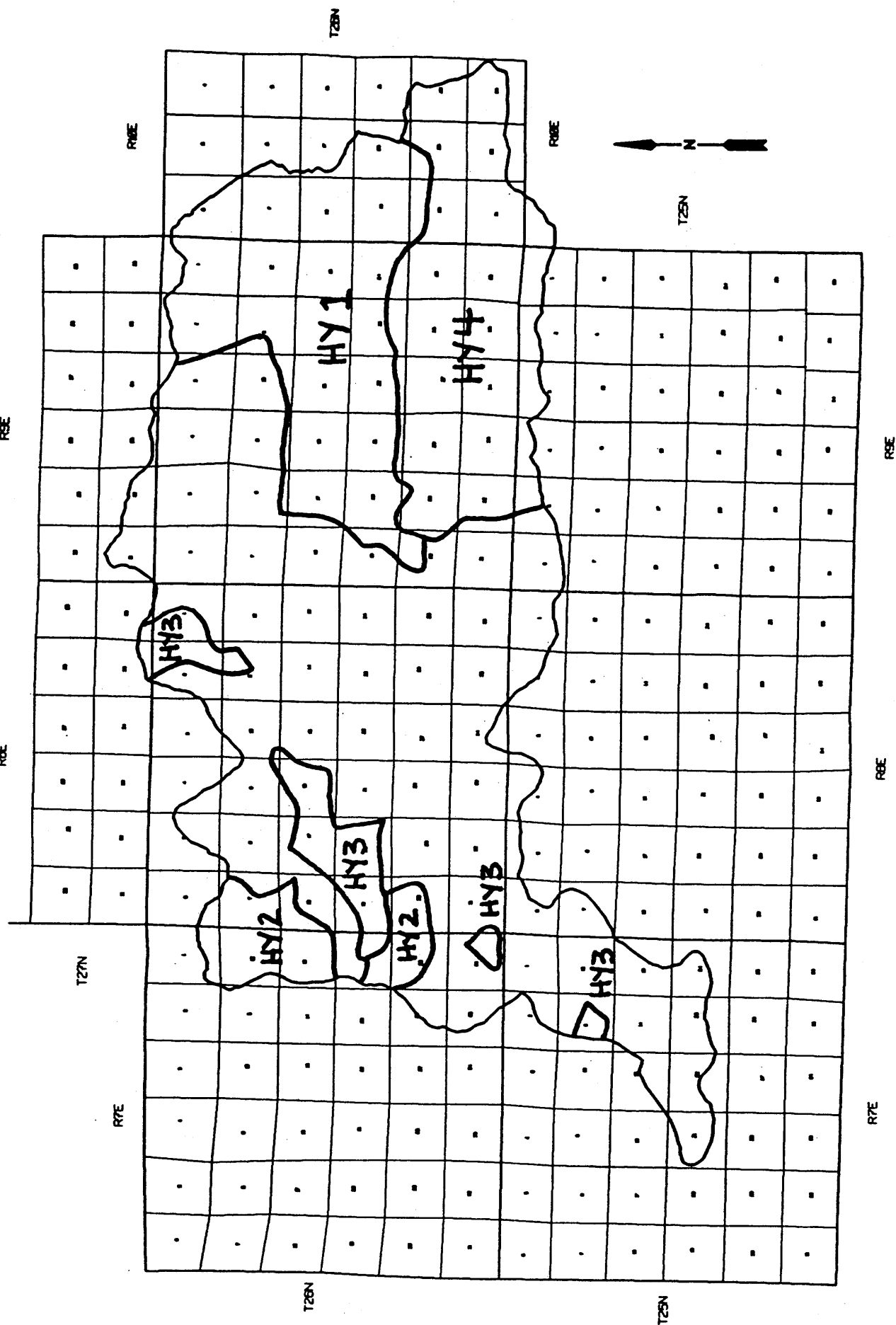
Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustained LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

- Minimizes disturbances that cause fine sediment erosion in Type 4 and 5 stream channels.
- Minimizes disturbances that cause fine sediment erosion near Type 4 and 5 waters.
- Minimizes disturbance on sensitive sub-surface drainage areas.
- Slope/Horizontal, soil exposure/compaction distances, from King County Surface Water Management.
- Protects exposed mineral soil from delivery to streams. Protective covers such as duff and mulch help prevent particle detachment. In areas of compacted soils and concentrated runoff, Walt Megahan has found through his work that obstructions such as rocks and slash are most effective in trapping sediment impounded by surface flow.

TOLT HYDROLOGY



WAU: TOLT

Resource Sensitivity Number:

HY1 (Refer to Tolt Hydrology Map)

Situation Sentence for the Area (from causal mechanism report):

Potential increased peak flows from altered snow accumulation and melt rates can cause channel destabilization and bank erosion of inner gorge segments. This can contribute to debris flow failure and loss of rearing and spawning habitat for native cutthroat trout.

Triggering Mechanism (from causal mechanism report):

Removal of forest cover leads to both increased accumulation of snow and increased snow melt rates. Lack of forest cover or young forest cover allows more snow to accumulate on the ground rather than retaining the snow in the canopy for melt or evaporation. Lack of forest cover allows greater wind movement through the stand. This in turn increases latent and sensible heat transfer to the snowpack yielding higher melt rates and larger melt volumes.

In the Rain-on-Snow zone we expect rain-on-snow effects to be most frequent since snow accumulation is frequent. In terms of designing forest harvesting plans it should be considered a primary effect.

Rule Call for Management Prescriptions (from causal mechanism report):
Prevent or Avoid

Field Observations:

Prescriptions:

This Hydrology Prescription is to be reevaluated in 5 years when it is anticipated that CMER research and Tolt River monitoring will provide additional data and methods to assess the effects of flow increases on vulnerable public resources.

Apply Tolt Basin Hydrology Method described below.

Monitoring should include examination of stream bank integrity and existing channel conditions to assess their sensitivity to peak flow events.

Justification for Prescriptions:

These prescriptions assume higher permissible flow increase on channels that are least sensitive because of channel materials and condition. The prescriptions assume lower flow increases on the most sensitive channels. Information from basin plans that have been prepared for other basins in King County indicate that channel instability is likely if the 2-year floods increase by more than 20% compared to hydrologically mature conditions. On the Tolt sub-basins this is equivalent to the

2-year flood increasing to the magnitude of a 5 year flood. This 20% increase roughly equates to the B-C risk class boundary in the DNR rain-on-snow rules (reference, WAC 222-22-100(2)), for a basin entirely within the rain-on-snow or snow dominated zone.

Damage to fish resources from scour may occur at some lower level of flow increase, before obvious channel instability becomes evident. This level may vary depending on stream characteristics; however, this needs more research to be clearly defined. It was generally agreed by the hydrologists and prescription team that flow increases of 10% or less were unlikely to cause detrimental effects. Given the lack of data, we selected a lower threshold of an 11% increase in the 2-year flood, at which the most sensitive channels were likely to be affected.

The 11% threshold increase was used to select the watershed regions for which hydrology Causal Mechanism Reports were written. The 11% increase roughly equates to the A-B risk class boundary in the DNR rain-on-snow rules, for a basin entirely within the rain-on-snow or snow dominated zone.

There is not at present a public water supply in area HY1 and proposed forest practices during the term of this prescription are unlikely to significantly alter basin conditions should a public water supply be installed in the future.

Tolt Basin Hydrology Method For HY1 Areas

Introduction

When a landowner has identified a proposed area for harvest within HY1 the landowner will conduct an analysis of potential peak flows to vulnerable public resources. The objective of the following methodology is to document the study methods and results of an analysis of the proposed harvest with the goal of reducing the occurrence of peak flows to vulnerable public resources. The proposed harvest unit will be investigated using the outline in Figure 5.

If the proposed forest harvest is located in area HY1, proceed through the Level I hydrology methods, using the most current revision, for the sub-basin of the proposal.

Calculate the 2-year discharge with the proposed harvest and compare this to the 2-year flood under fully mature conditions (Q2h:Q2m). Calculations are to be based on the basin above the downstream mouth of the Type 3 stream.

If the proposed harvest will not increase the relevant sub-basin peak flow discharge for the 2-year flow by 11 percent or more, or if it can be documented that the channels downstream from the proposed forest practice are not sensitive to increases in peak flows, follow standard forest practices rules. Documentation of channel sensitivity will include, as a minimum: field verified channel materials and conditions, estimated peak flow history of the relevant channels, and interpretation of the aerial photograph history of the channels. Types of downstream channel materials and conditions that may not be sensitive to peak flows would include, but not be limited to, bedrock or block controlled channels.

If the increase in peak flow is greater than 11 percent, use the channel sensitivity methods (reference "Field Assessment Of Stream Channel Conditions", Jones and Stokes Associates, 2/10/92, inserted in Hydrology Prescriptions) on the Type 3 channel adjacent to and downstream from the proposed harvest activity. Calculate scores for both existing and potential conditions, and apply the higher of these scores to the flow chart criteria.

If the score is 0 or 1, use standard forest practices rules.

If the score is 2, develop an explicit mitigation plan that addresses the sensitive channel aspects and reduces the score to 0 or 1, or maintain the relevant sub-basin area percent increase in the 2-year peak flow (Q2h:Q2m) to less than 17 percent.

If the score is 3 develop an explicit mitigation plan that addresses the sensitive channel aspects and reduces the score to the 0, 1, or 2 categories, or maintain the relevant sub-basin area percent increase in the 2-year peak flow (Q2h:Q2m) to less than 14 percent.

If the score is 4 or the relevant sub-basin area percent increase in the 2-year peak flow (Q2h:Q2m) is greater than 20 percent, no clearcut harvest or proceed with an Alternate Plan forest practice application.

Explicit mitigation is the design and analysis of specific actions that address the potential impacts to vulnerable public resources. Explicit mitigation plans will be presented in design reports with drawings, specifications, and implementation standards. Examples of explicit mitigation might include: establish channel flood zone buffers in downstream reaches, install functional LOD, channel bank restoration, or limited harvest.

WAU: TOLTResource Sensitivity Number: HY2 (Refer to Tolt Hydrology Map)

Situation Sentence for the Area (from causal mechanism report):
Increased peak flow from altered snow accumulation and melt rates can reduce coho spawning habitat.

Triggering Mechanism (from causal mechanism report):

Removal of forest cover leads to both increased accumulation of snow and increased snow melt rates. Lack of forest cover or young forest cover allows more snow to accumulate on the ground rather than retaining the snow in the canopy for melt or evaporation. Lack of forest cover allows greater wind movement through the stand. This in turn increases latent and sensible heat transfer to the snowpack yielding higher melt rates and larger melt volumes.

In the rain-on-snow zone we expect rain-on-snow effects to be most frequent since snow accumulation is frequent. In terms of designing forest harvesting plans it should be considered a primary effect.

Rule Call for Management Prescriptions (from causal mechanism report):

Minimize or Prevent

Field Observations:

Prescriptions:

Apply current DNR rain-on-snow rules.

Justification for Prescriptions:

From the basin-scale perspective, these units will be satisfactorily protected from ROS effects with Standard Rules:

- 1) The method described in the Watershed Analysis Manual over-estimates the snow available for melt at these lower elevations (rain dominated zone).
- 2) Through the watershed analysis process these channels were not identified as being sensitive to peak flows. These reaches did not show significant changes in response to peak flow, e.g. November 1990 floods. Therefore, they are unlikely to be sensitive to small changes in peak flows.
- 3) Washington State Department of Natural Resources WAC 222-22-100(2).

WAU: TOLTResource Sensitivity Number: HY3 (Refer to Tolt Hydrology Map)

Situation Sentence for the Area (from causal mechanism report):
Increased peak flow from altered snow accumulation and melt rates may cause channel scour, which reduces cutthroat spawning habitat.

Triggering Mechanism (from causal mechanism report):
Removal of forest cover leads to both increased accumulation of snow and increased snow melt rates. Lack of forest cover or young forest cover allows more snow to accumulate on the ground rather than retaining the snow in the canopy for melt or evaporation. Lack of forest cover allows greater wind movement through the stand. This in turn increases latent and sensible heat transfer to the snowpack yielding higher melt rates and larger melt volumes.

In the rain dominated zone we expect rain-on-snow effects to be most infrequent since snow accumulation is infrequent. Nonetheless in the upper elevations of the zone it may be important. In terms of designing forest harvesting plans it should be considered a primary effect.

Rule Call for Management Prescriptions (from causal mechanism report): Prevent or Avoid
Field Observations:

Prescriptions:
Apply current DNR rain-on-snow rules.

Justification for Prescriptions:
From the basin-scale perspective, these units will be satisfactorily protected from ROS effects with Standard Rules justification:

- 1) The method described in the Watershed Analysis Manual over-estimates the snow available for melt at these lower elevations (rain dominated zone).
- 2) Through the watershed analysis process these channels were not identified as being sensitive to peak flows. These reaches did not show significant changes in response to peak flow, e.g. November 1990 floods. Therefore, they are unlikely to be sensitive to small changes in peak flows.
- 3) Washington State Department of Natural Resources WAC 222-22-100(2).

Form 3-1. Prescription-Writing Worksheet

WAU: Tolt

Resource Sensitivity Number:

HY4 (Refer to Tolt Hydrology Map)

Situation Sentence for the Area (from causal mechanism report):

Increased peak flows from altered snow accumulation and melt rates combined with timber harvest, may cause rain-on-snow (ROS) events. This can increase turbidity in the reservoir and degrade spawning habitat in tributaries and the lower alluvial segments.

Increased peak flows from altered snow accumulation and melt resulting from timber harvest, may cause erosion of stream banks and inner gorge sediments. These additional sediment inputs may reduce rearing and spawning habitat for native cutthroat trout.

Increased peak flows from altered snow accumulation and melt resulting from timber harvest, may increase the transport of sediment generated from forest roads (surface erosion and mass wasting) and erosion of stream banks. Increased transport of fine sediment can increase turbidity in the South Fork Tolt Reservoir.

Triggering Mechanism (from causal mechanism report):

Removal of forest cover leads to both increased accumulation of snow and increased snow melt rates. Lack of forest cover or young forest cover allows more snow to accumulate on the ground rather than retaining the snow in the canopy for melt or evaporation. Lack of forest cover allows greater wind movement through the stand. This in turn increases latent and sensible heat transfer to the snowpack yielding higher melt rates and larger melt volumes.

In the rain-on-snow zone we expect rain-on-snow effects to be most frequent since snow accumulation is frequent. In terms of designing forest harvesting plans it should be considered a primary effect.

Rule Call for Management Prescriptions (from causal mechanism report):

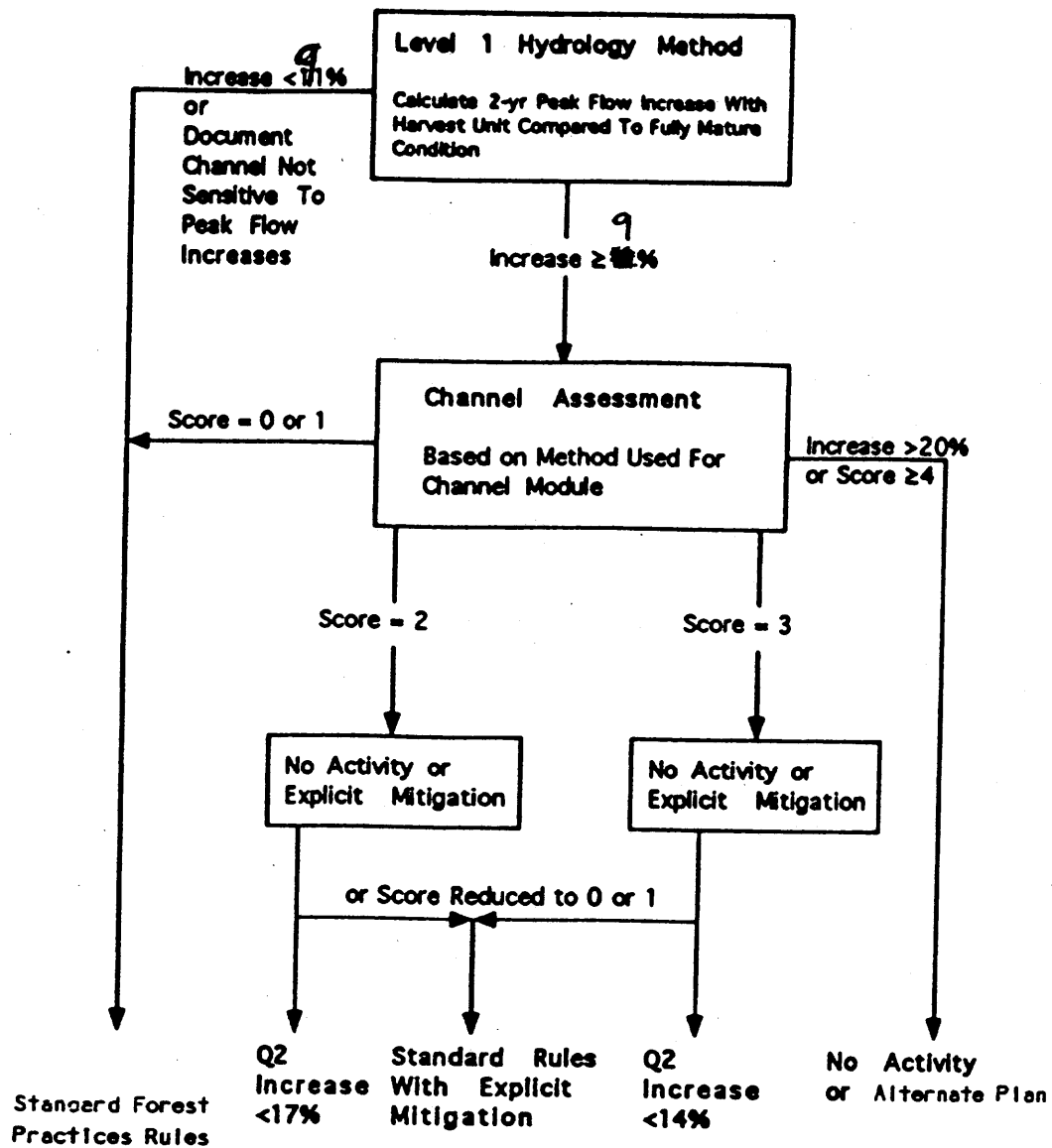
Prevent or Avoid

Field Observations:

Prescriptions:

The prescriptions for HY4 are the same as for HY1 with the exception that the sub-basin scale for which the analysis is performed is for Type 4 creeks because of the added significance of water quality for the South Fork Tolt Reservoir in area HY4.

FIGURE 5. TOLT BASIN HYDROLOGY METHOD FLOWCHART



Field Form

FIELD ASSESSMENT OF STREAM CHANNEL CONDITIONS

Stream: _____ WR1A/F: _____ Sub-WR1A/F: _____ Walk: _____ Reach #1: _____
 Surveyor: _____ Reach length: _____ ft/m Average wetted width: _____ ft/m
 Date: _____ Flow today is: High Medium Low

Reach location: _____

Walk the study reach and observe the conditions of the channel bed and banks (length of the study reach should be at least 20 times the active channel width). If conditions such as confinement of the channel, stream gradient, or dominant channel bed or bank material change significantly, then a new reach should be described.

After walking the reach, fill in the blanks and circle the letter responses to describe conditions within the channel. If none of the descriptions fit, do not circle any responses, but supply comments to describe the condition. If applicable, more than one response can be circled for an item.

I. FACTORS AFFECTING CHANNEL RESPONSE

A. Channel Constraint

Average active channel width = _____ feet/meters

Average valley bottom width = _____ feet/meters

VBW/ACW = _____

Meandering: a. straight (= 1) b. slightly sinuous (1.1-1.3) c. sinuous (1.4-1.7) d. meandering (>1.7)

B. Resistance of Channel Bank Material

Source of material: alluvial glacial till colluvial lacustrine sediments bedrock unknown other _____

Can the stream move the majority of the bed material short during high flows? Yes No

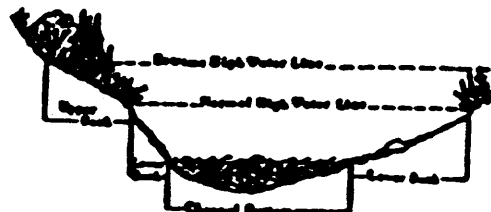
Can the stream erode the banks during high flows? Yes No Only in a few places

C. Influence of Upper Banks

Average upper bank slope = _____ %

Can the stream undercut the upper banks? Yes No

If yes, would this result in mass wasting? Yes No



D. Stream Energy

Average channel gradient = _____ %

Is the profile 'stairstepped'? Yes No

If yes, what forms the steps? Bedrock Boulders Woody debris

Do the steps appear stable? Yes No

Position in drainage network:

a. 1st order headwater stream

c. 4th order mainstem

b. 2nd or 3rd order tributary

d. 5th order or larger river

From flow chart, response category is:

Type A: unconstrained

Type B: slightly constrained, unconsolidated bottom

Type C: laterally constrained, unconsolidated bottom

Type D: constrained, bedrock/large boulder

Type E: boulder/bedrock stairstep

Type F: woody debris stairstep

II. CONDITION OF CHANNEL BANKS

A. Channel Capacity

1. Response Category Type A or B (channel with floodplain):

a. active channel carries average annual flood, larger events spread across floodplain

b. active channel has downcut or widened, so peak flows merely spread over the floodplain

c. active channel has downcut and/or widened to the extent that peak flows never spread over the floodplain; an inner terrace has developed within the "blowout" channel area, marking a new active channel

d. a major flood has passed through and caused obvious damage in this channel

1. Response Category Type C, D, E, F (channels without floodplain)
 - a. active channel area appears adequate to carry average annual flood; streamside vegetation comes down to the active channel margin
 - b. active channel area shows signs of enlargement, new banks indicate some widening or downcutting; there is a flood-disturbed area that is greater than the active channel width
 - c. channel appears "blowout"; active channel area is much smaller than the flood-disturbed area within the valley bottom
 - d. a debris flow or flood has obviously come down this channel and caused damage

B. Degree of Existing Bank Cutting

1. Length of reach affected:

- | | |
|-----------|-----------|
| a. none | e. 51-75% |
| b. 1-10% | f. 75-90% |
| c. 11-30% | g. >90% |
| d. 31-50% | |

2. Location of bank cutting:

- a. nowhere in reach
- b. in expected places, such as outside of corners and constrictions
- c. in unusual places, such as straight stretches and inside of bends

3. Angle of banks exposed by cutting:

- a. vertical: ☐
- b. angled back: ☒
- c. undercut: ☐

C. Degree of Bank Protection

1. Predominant type of vegetation along the bank: (circle more than one if mixed)

- a. mature coniferous trees
- b. mature hardwood trees
- c. immature conifers 20-40 feet tall
- d. immature conifers 10-20 feet tall
- e. immature conifers 5-10 feet tall
- f. recent clearcut, trees <5 feet tall
- g. immature hardwood trees
- h. shrubs
- i. grass

2. Vegetation density:

- a. banks are well protected by a deep, dense root network, which is inferred from the dense, mature (well-established) forest
- b. banks are fairly well protected by deep roots with several open areas
- c. banks are protected by a dense but shallow root network, inferred from the dense, young trees or shrubs
- d. banks are poorly protected by a shallow root network with numerous openings
- e. banks receive little or no protection from roots

D. Resistance of Lower Bank Material

1. Bank rock content:

- | | |
|-----------------|----------------|
| a. 90-100% rock | d. 20-40% rock |
| b. 65-90% rock | e. <20% rock |
| c. 40-65% rock | |

2. Bank cohesion (kick the bank):

- a. resistant bedrock
- b. erodible bedrock
- c. cohesive silt/clay resistant to erosion
- d. cemented matrix of fine material containing rock particles
- e. cohesive but erodible silt/clay
- f. noncohesive assortment of mostly cobble and larger sizes
- g. noncohesive assortment of mostly cobble to gravel-size rocks
- h. noncohesive assortment of mostly gravel-size rocks
- i. noncohesive assortment of mostly fine material

Particle Size Classes

Large boulder: >24"
 Small boulder: 12-24"
 Cobble: 3-12"
 Gravel: 0.25-3"
 Fine: <0.25"

E. Flow Deflection into Banks (focus on thalweg)

- a. little or no deflection of flow into banks
- b. a few areas where flow is deflected into the banks by logs, boulders, or the channel pattern
- c. numerous areas where flow is deflected into channel banks by logs, boulders, or the channel pattern

III. CONDITION OF CHANNEL BOTTOM

A. Deposition

1. Extent of bottom affected (consider active channel area, not just wetted area):

- very few fresh deposits
- 1-30% of bottom affected by deposition, mostly isolated patches behind large boulders or small point bars
- 30-50% of bottom covered with fresh deposits, such as several small point bars or patches behind boulders or woody debris
- 50-75% of bottom covered with fresh deposits, such as large mid-channel or point bars
- >75% of bottom covered with fresh deposits

2. Size of dominant material in deposits

- most particles cobble-size and larger
- most particles are gravel to cobble-size
- particles are mostly gravel with some finer material
- particles are mostly fines (sand and smaller sizes)

B. Evidence of Recent Bed Mobility

- in all but channel thalweg, rocks are "dull"; bed materials show definite staining, algae growth, or have clinging vegetation; bed materials are never or only rarely mobile
- throughout the channel, there is a mix of "bright" and "dull" rocks; staining or algae growth or clinging vegetation is evident in some places
- mostly "bright" rocks; some staining or algae growth or clinging vegetation is evident in sheltered backwater areas
- nearly all "bright" rocks; there is no evidence of staining, algae growth, or clinging vegetation; majority of bed materials appear to be quite mobile during high flows

C. Armoring (pick up some rocks and look at subsurface particles)

Within the wetted channel, are surface particles distinctly larger than subsurface particles?
Yes No

On bars, are surface particles distinctly larger than subsurface particles?
Yes No

D. Particle Size Distribution

- substrate sizes are typical for the size of stream and position in the drainage network, large and small materials present
- slight reduction in distribution of smaller particles
- smaller particles are absent or present only in fresh deposits on bars

E. Dominant Particle Sizes

- bedrock/large boulder
- large and small boulders
- large and small boulders, some cobbles
- mostly cobble with some boulders
- cobble/gravel
- mostly gravel
- mostly fines

F. Angularity

- substrate consists mostly of flat or angular rocks resistant to rolling
- substrate consists mostly of subangular rocks, some flat or rounded rocks present
- substrate consists mostly of rounded rocks that have little resistance to rolling

G. Particle Packing (kick the bottoms)

- larger particles are surrounded by smaller or overlapping ones, creating a tightly packed substrate resistant to scour
- some overlap and particle packing, larger rocks can be moved with your foot but smaller particles create a tightly packed matrix resistant to erosion
- larger particles are surrounded by a loose matrix of smaller particles
- bottom is very loose, most particles can be moved with your foot

IV. OTHER INDICATORS

A. Location of Woody Debris

- a. individual logs within or adjacent to the wetted channel area
- b. clumps or jams within or adjacent to the wetted channel area
- c. clumps or jams along the outer margin of the active channel area
- d. individual logs along the outer margin of the active channel area
- e. most of the logs have been deposited above and outside of the active channel area
- f. a debris jam blocks the channel
- g. numerous debris jams block the channel
- h. most logs have been transported to a lower reach of the channel
- i. numerous logs have been deposited within this reach from upstream
- j. there are no logs in or adjacent to the channel

B. Culverts and Bridges

Describe culverts or bridges within or near the study reach (size, condition, location of rust lines on culvert, capability for handling flood flows and debris)

C. Channel Controls

Describe riprap or levees that have been constructed along the channel (which bank, length, height, effectiveness)

D. Known History of Flooding or Debris Flows

Note date, magnitude of flood event, probable cause, source of information

E. Other Observations

EVALUATION OF CHANNEL CONDITIONS

Using the Field Assessment, score each item: 1 = applicable to the surveyed reach, or 0 = does not apply. Record the score in the columns indicated.

"Red Flag" Conditions	Existing	Potential
I. Response Category Type = A, B, or C		_____
II. Channel Banks		
A. Channel Capacity = b, c, or d	_____	
B. Bank Cutting		
1. (1. Length) > 30% and (2. Location) = c	_____	
2. (1. Length) > 30%	_____	
C. Degree of Bank Protection		
1. (2. Density) = c, d, or e and banks are not predominantly resistant bedrock		_____
D. Resistance of Bank Material		
1. (1. Rock content) = d or e and (2. Cohesion) = d, e, g, h, or i		_____
2. (1. Rock content) = b or c and (2. Cohesion) = g or h		_____
E. Flow Deflection = c		_____
III. Channel Bottom		
A. Deposition		
1. (1. Extent) = c and (2. Size) = d	_____	
2. (1. Extent) = d or e	_____	
B. Recent Bed Mobility = d	_____	
C. Armoring		
"yes" for either wetted channel or bank	_____	
D. Particle Size Distribution = c	_____	
E. Particle Size = c or f or g		_____
F. Angularity = c		_____
G. Particle Packing = c or d		_____
IV. Other Indicators		
A. Woody Debris		
location = a, h, or i	_____	_____
location = f, g		_____
B. Culverts or Bridges Appear Inadequate		_____
Total Score =	_____	_____

Interpretation - "Existing" Column

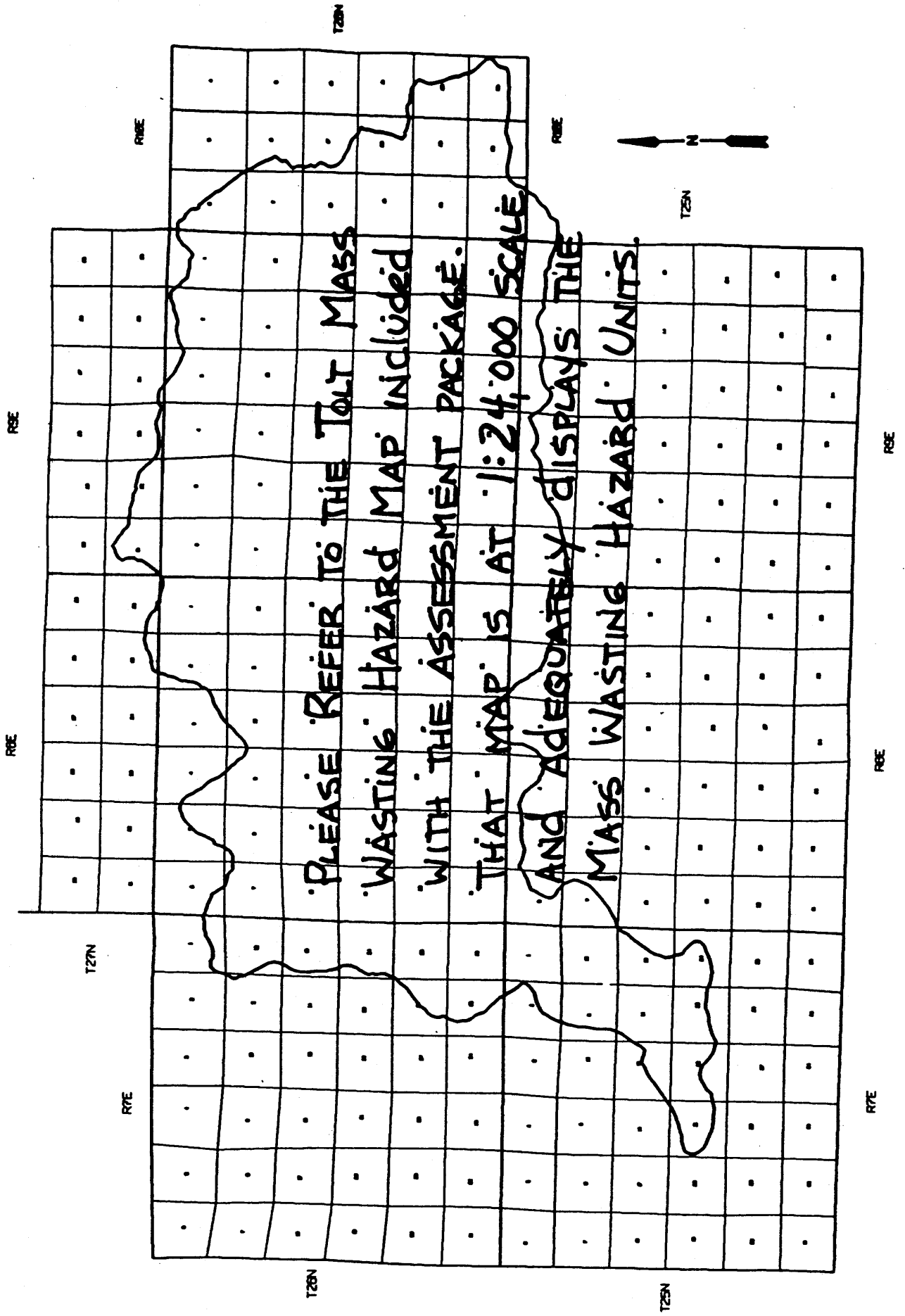
- 21 Channel conditions indicate little or no existing damage related to increased peak flows
- 2-3 Channel conditions indicate a moderate degree of existing damage, further investigation should be used to determine the specific cause of items scored above
- 24 Channel conditions indicate significant channel damage has occurred

Interpretation - "Potential" Column

- 21 Channel conditions indicate the channel has a low potential for damage if peak flows increase
- 2-3 Channel conditions indicate the channel has a moderate potential for damage if peak flows increase
- 24 Channel conditions indicate the channel has a high potential for damage if peak flows increase

MASS-WASTING UNITS

TOLT MASS WASTING HAZARD



WAU: TOLT

Resource Sensitivity Number:

Mass Wasting Hazard Unit #1

Deeply incised inner gorge (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Coarse and fine sediment from past landslides in Unit #1 associated with roads and timber harvest within inner gorges has reduced pools and degraded cutthroat (and possibly Dolly Varden and bulltrout) spawning and summer and winter rearing habitat in the North Fork braided reaches (Segments 13, 15, 17). Sediment from this unit is also routed downstream and can affect depositional areas such as segments 1, 2, 3 and 5.

Triggering Mechanism (from causal mechanism report):

Failures are mainly associated with roads, both sidecast failures and fill failures. Stream crossing failures are the result of the active transport of wood debris and bedload down these channels, causing plugged culverts. Harvest of the very steep slopes adjacent to streams has accelerated mass wasting. This is due to root strength deterioration and changes in groundwater hydrology. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturated thickness causing failure. Given the elevation and rock type, root strength is the more important of the two.

Rule Call for Management Prescriptions (from causal mechanism report):

Prevent or Avoid

Field Observations:

Prescriptions:

Use Mass Wasting Prescription Methodology, described below

Voluntary Prescription:

Landowner may elect to work cooperatively with affected Indian tribes and appropriate state agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard areas included within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically

evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

TAU: TOLT

Resource Sensitivity Number:

Mass Wasting Unit #2

Unstable portions of ancient landslides (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Predominantly fine and some coarse sediment from toes and unstable portions of ancient landslides in Unit #20 (scattered throughout watershed) associated with underlying weak material and interrupted drainage patterns has reduced pool volume and locally degraded spawning gravel. These directly deliver to the mainstem, North Fork and South Fork where they are undercut by the stream. They also deliver to tributaries (Crazy Creek). Fines from these units increase turbidity.

Triggering Mechanism (from causal mechanism report):

Past failure has disrupted surface and subsurface drainage patterns. Portions of the failures have become over-steepened by either past failure or subsequent stream and river erosion. In the glacial material, occurrence of the natural sporadic deep seated failures due to lower strength of the material and groundwater is very important. Root strength will play a role in areas that have been over-steepened by stream erosion.

Rule Call for Management Prescriptions (from causal mechanism report):

Prevent or Avoid

Field Observations:

Prescriptions:

See Mass Wasting Prescriptions Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent

with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

WAU: TOLT

Resource Sensitivity Number: Mass Wasting Unit #3
Trace of distinct fault (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):
Coarse and fine sediment from past mass wasting in Unit #3 associated with clearcut logging around the trace of a distinct fault is being routed through Segments 122 and 124 to Segments 121, 123, 120 and 119, and also Segments 62 and 58. This is causing localized degradation of spawning gravel and rearing habitat for cutthroat.

Triggering Mechanism (from causal mechanism report):
Decreases in root strength and changes in hydrology contribute to the increased landslide frequency of non-road related failures. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturated thickness causing failure.

Rule Call for Management Prescriptions (from causal mechanism report): Prevent or Avoid

Field Observations:

Prescriptions:
See Mass Wasting Prescription Methodology

Voluntary Prescription:
Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:
The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

WAU: TOLT

Resource Sensitivity Number:

MASS WASTING UNIT #4

Precipitous slopes along the ice margin boundary (Refer to ~~T~~
Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Coarse and fine sediment from past mass wasting in Unit 4-2 and 4-3 associated with road sidecast and clearcut logging on precipitous straight slopes is being routed through Segments 122 and 124 to Segments 121, 123, 119 and 120. This causes localized degradation of spawning gravel and rearing habitat for cutthroat trout. Delivery of other subunits (4-1, 4-4, 4-5) to other tributaries is possible.

Triggering Mechanism (from causal mechanism report):

Failures originating from sidecast roads accounted for the majority of the failures within this unit. Decreases in root strength and changes in hydrology contribute to the increased landslide frequency of non road related failures. The larger melt rates and volumes due to clearcut harvest may lead to and increase in saturated thickness causing failure.

Rule Call for Management Prescriptions (from causal mechanism report):

Prevent or Avoid

Field Observations:

Prescriptions:

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to

bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

WAU: TOLT**Resource Sensitivity Number:**Mass Wasting Unit #5

Older alpine drift over bedrock on precipitous slopes (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Coarse and mostly fine sediment from past mass wasting in Unit #5 associated with roading and timber harvest on precipitous straight slopes increases turbidity in the reservoir and degrades the water supply.

Triggering Mechanism (from causal mechanism report):

Debris torrents occur along the contact between the road and the bedrock. Loss of root strength and changes in hydrology aggravates the situation. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturated thickness causing failure.

Rule Call for Management Prescriptions (from causal mechanism report): Prevent or Avoid

Field Observations:**Prescriptions:**

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

WAU: TOLT**Resource Sensitivity Number:**Mass Wasting Unit #6Oversteepened slopes opposite ancient landslides (Refer to ~~T~~
Mass Wasting Hazard Map)**Situation Sentence for the Area (from causal mechanism report):**

Coarse and fine sediment from past mass wasting and recent hillslope erosion in Unit #6 associated with roading on precipitous stream adjacent slopes in reducing pools and degrading spawning gravel quality in localized areas of segments 13 and 14. This results in a degraded spawning, summer and winter rearing habitat for resident cutthroat and possibly Dolly Varden and rainbow. Sediment from this unit is also routed downstream and can affect depositional areas such as Segments 1, 2, 3 and 5.

Triggering Mechanism (from causal mechanism report):

Construction of side roads on extremely steep uncompacted glacial material has resulted in large backslope failures and dry ravel. Decreased root strength due to harvest also plays a role in failures higher on the slope.

Rule Call for Management Prescriptions (from causal mechanism report):Prevent or Avoid**Field Observations:****Prescriptions:**

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- **Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.**

WAU: TOLT**Resource Sensitivity Number:**Mass Wasting Unit #7

High elevation pre-Fraser glacial deposits (inner gorge) (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Coarse and fine sediment from debris torrents and shallow rapid landslides in Unit #7 associated with timber harvest in inner gorge areas is reducing pools and degrading spawning gravel quality for resident cutthroat, steelhead, chinook, and coho salmon in Segments 5 through 12. Fine sediment is also increasing turbidity in segments downstream of unit #7.

Triggering Mechanism (from causal mechanism report):

These are naturally unstable slopes. Debris torrent frequency is accelerated from loss of root strength and changes in hydrology. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturated thickness causing failure.

Rule Call for Management Prescriptions (from causal mechanism report):Prevent or Avoid**Field Observations:****Prescriptions:**

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

WAU: TOLT

Resource Sensitivity Number:

Mass Wasting Unit #8

High elevation pre-Fraser glacial deposits (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Coarse and fine sediment from debris torrents and shallow rapid landslides in Unit #8 associated with roading and clearcut logging in steep and convergent topography is reducing pools and degrading spawning gravel quality for resident cutthroat, steelhead, chinook, and coho salmon in Segments 5 through 12 and Segment 31. Coarse and fine sediment is routed downstream and affects Segments 1-3.

Triggering Mechanism (from causal mechanism report):

These are naturally unstable slopes. Debris torrent frequency is accelerated from loss of root strength and changes in hydrology. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturated thickness causing failure.

Rule Call for Management Prescriptions (from causal mechanism report):

Prevent or Avoid

Field Observations:

Prescriptions:

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- **Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.**

WAU: TOLT**Resource Sensitivity Number:****Mass Wasting Unit #9**

Steep rock slopes covered with a thin mantle of glacial deposits (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Fine and coarse sediment from past mass wasting (debris torrents and shallow rapid landslides) in Unit #9 associated with roading and clearcut logging on straight, precipitous slopes is being routed through Segments 56 and 55 and, possibly, Dry Creek to Segment 14 and 13. Increased fine and coarse sediment is causing reduced pool volume and localized degradation of spawning, summer and winter rearing habitat for cutthroat trout. Extensive aggravation causes a portion of the flow to go subsurface in Dry Creek.

Triggering Mechanism (from causal mechanism report):

Decreases in root strength and changes in hydrology contribute to the increased landslides frequency. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturated thickness causing failure.

Rule Call for Management Prescriptions (from causal mechanism report):**Prevent or Avoid****Field Observations:****Prescriptions:**

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- **Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.**

WAU: TOLT**Resource Sensitivity Number:**Mass Wasting Unit #10

Steep unstable slopes directly adjacent to the main river systems (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Mostly fine and some coarse sediment from shallow rapid landslides and over-steepened slopes due to bank erosion area directly deliver to the mainstem and South Fork Tolt. The mass wasting associated with roading and clearcut logging on precipitous slopes adjacent to the mainstem and South Fork (river bends in particular) reduces pool volume and degrades spawning gravel quality for steelhead, chinook and coho.

Triggering Mechanism (from causal mechanism report):

River erosion has steepened all of these slopes, some to an extremely steep angle. These slopes fail naturally but decreases in root strength or changes in hydrology or ground disturbance contribute to increased landslide occurrence. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturated thickness causing failure.

Rule Call for Management Prescriptions (from causal mechanism report):

Prevent or Avoid

Field Observations:**Prescriptions:**

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- **Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.**

WAU: TOLT**Resource Sensitivity Number:**Mass Wasting Unit #11

Unstable mass wasting deposits (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Fine and coarse sediment from unstable mass wasting deposits in Unit #11 associated with timber harvest and roading on unstable deposits is being delivered to Segment 15. The toe of these deposits are also being undercut by the North Fork Tolt. This area is contributing fine and coarse sediment to a braided segment overloaded causing additional loss of pool volume and degraded spawning and rearing habitat for cutthroat trout. Sediment for Unit #11 is routed downstream and affects Segment 5 on the North Fork and Segments 1-3 on the mainstem.

Triggering Mechanism (from causal mechanism report):

These weak landslide deposits are subject to increased landslide activity due to decline in root strength, changes in hydrology, and ground disturbance related to harvest activities. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturated thickness causing failure.

Rule Call for Management Prescriptions (from causal mechanism report):Prevent or Avoid**Field Observations:****Prescriptions:**

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

WAU: TOLT

Resource Sensitivity Number:

Mass Wasting Unit #14

Distinct glacial cirques (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Coarse and fine sediment from debris torrents and shallow rapid landslides associated with sidecast roads and timber harvest in cirque basins in being routed down steep tributaries to the North Fork Tolt and the reservoir. This is adding to the reduced pool volume and degraded gravel quality in the North Fork, which degrades summer rearing and spawning habitat. It also causing increased turbidity in the reservoir.

Triggering Mechanism (from causal mechanism report):

Nearly half of the failure in this unit were road failures originated from sidecast roads. Natural failures accounted for 5 of the 6 non-road related failures. Natural failure frequency increases due to root strength deterioration and changes in hydrology. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturate thickness causing failure.

Rule Call for Management Prescriptions (from causal mechanism report):

Prevent or Avoid

Field Observations:

Prescriptions:

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

WAW: TOLT

Resource Sensitivity Number:

Mass Wasting Unit #15

Straight smooth bedrock slopes (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Coarse and fine sediment from debris torrents in Unit #15 associated with sidecast roads on straight smooth slopes increases reservoir turbidity affects resident cutthroat trout spawning habitat in the lower section of Segments 147, 149, 151, and 153.

Triggering Mechanism (from causal mechanism report):

Failures originating from sidecast roads accounted for the majority of the failures within this unit. Decreases in root strength and changes in hydrology may have contributed to the increased landslide frequency of non-road related failures. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturated thickness causing failure.

Rule Call for Management Prescriptions (from causal mechanism report):

Prevent or Avoid

Field Observations:

Prescriptions:

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

WAU: TOLT**Resource Sensitivity Number:**Mass Wasting Unit #16

Steep bedrock slopes, some strongly convergent topography
(Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Coarse and fine sediment from mass wasting in Unit #16 associated with sidecast roads and timber harvest on colluvial soils over steep bedrock soils is being routed through steep tributaries to the braided segments of the North Fork Tolt and the reservoir. This causes additional reductions in pool volume and localized degradation of spawning gravel in the North Fork, and degrading summer and winter rearing and spawning habitat for cutthroat and possibly Dolly Varden and bulltrout. It also increases turbidity and degrades water quality in the reservoir. Sediment is also routed downstream and affects depositional areas such as Segment 5 on the North Fork and Segments 1-3 on the mainstem.

Triggering Mechanism (from causal mechanism report):

Failures originating from sidecast roads accounted for the majority of failures within this unit. Decreases in root strength and changes in hydrology contribute to the increased landslide frequency of non-road related failures. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturated thickness causing failure.

Rule Call for Management Prescriptions (from causal mechanism report):

Prevent or Avoid

Field Observations:**Prescriptions:**

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In

general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

WAU: TOLT**Resource Sensitivity Number:**Mass Wasting Unit #17

Precipitous ice margin slopes - Low probability of delivery
(Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Fine and coarse sediment from shallow rapid landslides in Unit #14 associated with sidecast roads on straight slopes reduce resident cutthroat rearing habitat in Segments 119 and 120 by reducing the number and volume of pools.

Triggering Mechanism (from causal mechanism report):

Failures originating from sidecast roads account for the majority of failures within this unit. Decrease in root strength and changes in hydrology contribute to the increased landslide frequency of non-road related failures. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturated thickness causing failure.

Rule Call for Management Prescriptions (from causal mechanism report):

Prevent or Avoid

Field Observations:**Prescriptions:**

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved with or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

WAU: TOLT**Resource Sensitivity Number:**Mass Wasting Unit #18

Precipitous slopes in porous glacial material (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Primarily fine and some coarse sediment from shallow rapid landslides in Unit #18 associated with streambank erosion on the outside of bends contribute to pool filling in Segment 12b and is being routed through the North Fork Canyon to the depositional area in Segment 5 and Segment 1-3. This reduces pool volume and causes temporary degradation of spawning gravel for resident trout as well as anadromous species in the North Fork.

Triggering Mechanism (from causal mechanism report):

These are slopes that are on the outside bends of the river and the primary trigger mechanism is stream erosion.

Rule Call for Management Prescriptions (from causal mechanism report):Prevent or Avoid**Field Observations:****Prescriptions:**

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

VAU: TOLT

Resource Sensitivity Number: Mass Wasting Unit #19
Precipitous rock faces with potential delivery (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):
Coarse and fine sediment from shallow rapid landslides in Unit #19 associated with precipitous rock faces is delivered to several low gradient streams in the watershed (Stossel Creek, N. Fork Creek, Lynch Creek, Segment 127). These streams are highly sensitive to coarse and fine sediment, and increased inputs cause pool filling and degraded spawning gravel quality, leading to degraded summer rearing and spawning for cutthroat trout and coho.

Triggering Mechanism (from causal mechanism report):
Very few landslides in this unit, does not seem to be sensitive to forest practices. Possible trigger mechanisms include loss of root strength and changes in hydrology. At elevations below typical snow cover and insulation effect during an extended cold weather period, seepages will gradually freeze shut, raising the hydrostatic pressure behind, and result in unusual slope failure as thaw occurs. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturated thickness causing failure.

Rule Call for Management Prescriptions (from causal mechanism report):
Prevent or Avoid

Field Observations:

Prescriptions:
See Mass Wasting Prescription Methodology

Voluntary Prescription:
Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:
The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data

brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

WAU: TOLT**Resource Sensitivity Number:**Mass Wasting Unit #20

Ancient deep seated landslides (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Coarse and fine sediment from shallow and deep-seated landslides in Unit #20 associated with roading on hummocky broken topography can deliver landslide debris, especially when undercut by the river. This reduces the number and volume of pools, increases bed material size and reduces spawning gravel availability resulting in summer rearing and spawning habitat for resident cutthroat and salmonids.

Triggering Mechanism (from causal mechanism report):

Decreases in root strength and changes in hydrology contribute to the increased landslide frequency of non-road related failures. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturated thickness causing failure. The larger water flow through the soil due to clearcut harvest may lead to an increase in groundwater saturated thickness along failure zones causing increased rates of movement.

Rule Call for Management Prescriptions (from causal mechanism report):Prevent or Avoid**Field Observations:****Prescriptions:**

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data

brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

WAU: TOLT

Resource Sensitivity Number:

Mass Wasting Unit #21

Bedrock river gorge (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Very coarse sediment from past rockfall in Unit #21 associated with freezing and thawing in joint of bedrock is creating falls and cascades which create a velocity barrier to migrating salmon in Segment 96 of the South Fork and Segment 8 of the North Fork.

Triggering Mechanism (from causal mechanism report):

Landslides (rockfalls) in this area probably triggered by expansion in joints by freezing and thawing, which may be affected by changes in hydrology.

Rule Call for Management Prescriptions (from causal mechanism report):

Prevent or Avoid

Field Observations:

Prescriptions:

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

WAU: TOLT

Resource Sensitivity Number:

Mass Wasting Unit #22

Steep upland valley walls in Qpf (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Mostly fine and some coarse sediment from shallow rapid landslide in Unit #22 associated with clearcut logging in steep upland valley walls directly delivery to the river. This reduces the number and volume of pools, and locally degrades spawning gravel quality. This effects salmonid and resident cutthroat spawning and rearing habitat in the South Fork (Segment 94 and 95), the North Fork (Segment 4 and 5) and the mainstem (Segment 2 and 3).

Triggering Mechanism (from causal mechanism report):

Decreases in root strength and changes in hydrology contribute to the increased landslide frequency of non-road related failures. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturated thickness causing failure.

Rule Call for Management Prescriptions (from causal mechanism report):

Prevent or Avoid

Field Observations:

Prescriptions:

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

WAU: TOLT**Resource Sensitivity Number:**Mass Wasting Unit #23

Steep rock face with possible glacial deposits (Refer to Tolt Mass Wasting Hazard Map)

Situation Sentence for the Area (from causal mechanism report):

Coarse and fine sediment from debris torrents and shallow rapid landslides in Unit #23 associated with sidecast roads and clearcut harvesting on straight, steep slopes can be delivered to Segments 37, 42, 48, 51, 52 and 56 (North Fork Creek). This sediment is routed to Segment 31 (North Fork Creek) and Segment 12 and 13 (North Fork), which are highly vulnerable to coarse sediment (and Segment 31 is highly vulnerable to fine sediment). This causes further reduction in summer rearing and spawning habitat for cutthroat trout. Sediment is also routed downstream and can affect Segment 5 of the North Fork and Segments 1-3 of the mainstem.

Triggering Mechanism (from causal mechanism report):

Failures originating from sidecast roads accounted for the road related failures within this unit. Decreases in root strength and changes in hydrology contribute to the increased landslide frequency of non-road related failures. The larger melt rates and volumes due to clearcut harvest may lead to an increase in saturated thickness causing failure.

Rule Call for Management Prescriptions (from causal mechanism report):Prevent or Avoid**Field Observations:****Prescriptions:**

See Mass Wasting Prescription Methodology

Voluntary Prescription:

Landowner elects to work cooperatively with Tribes and appropriate agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

The Tolt River basin analysis mapping did not resolve site-specific stability conditions to the detail needed by land managers. Field investigation shows that there are high hazard inclusion within moderate and low hazard areas and low hazard inclusions within high hazard areas. Because of this, there is a need to assess slope stability within unstable map units. The method produces a documented stability analysis that can be critically evaluated. The techniques that follow are patterned after and consistent with watershed analysis applications. In general, the methods are hierarchical, with more local data

brought to bear at a finer spatial scale, until the activity is approved or denied with adequate certainty.

- Factor of Safety adapted from USFS, (Personal conversations with Mt. Baker Snoqualmie National Forest and Intermountain Research Station) Ebasco, G.S. Sowers, 1979.

Mass Wasting Prescription Methodology

Introduction

When a landowner plans a forest practice activity in an identified mass wasting unit the landowner will conduct an analysis of potential mass wasting hazards and mitigation options. The analysis, prescription, and documentation are the responsibility of the landowner and will be provided with the forest practices application. The objective of the following methodology is to document the study methods and results of a field-based, site-specific analysis of the proposed harvest or road construction with the goal of reducing the occurrence of mass wasting failures that impact public resources to a level comparable to natural background levels. The proposed harvest unit or proposed road area will be investigated for mass wasting potential using the flow charts in Figures 1 through 4.

Mass wasting problems are grouped into two types; shallow rapid failures and deep seated failures. The methodology assesses failure types for road construction and harvest activities. The flow charts outline the procedures: Shallow Rapid Mass Wasting Flow Chart For Road Construction (Figure 1), Shallow Rapid Mass Wasting Flow Chart For Harvest (Figure 2), Deep Seated Landslide Flow Chart Roads and Harvest (Figure 3), and Mass Wasting Delivery Flow Chart Roads and Harvest (Figure 4).

The method starts by identifying if the proposed action is in a mass wasting unit with a rule call of prevent or avoid, minimize, or standard Forest Practice Rules. If the area is located in a low mass wasting hazard area (according to the Tolt Watershed Mass Wasting Hazard Map) then the rule call is standard Forest Practice Rules. If the area is in a high or moderate mass wasting hazard area, proceed through the shallow rapid and deep seated flow charts and associated text that follows.

Shallow Rapid Mass Wasting For Road Construction (Figure 1)

The objective for road building in mass wasting units identified as unstable is for road design to be stable. All proposed road segments with the potential to deliver sediment to public resources are identified using field and map data.

Determine if a failure would deliver sediment to a vulnerable surface water using the Mass Wasting Deliver Flow Chart and associated text. If the failure has a low delivery hazard rating, proceed with the hillslope and road surface erosion prescriptions. If the failure is classified as a high or moderate delivery hazard rating, proceed with further assessment. (Delivery determinations, Figure 1).

Collect site-specific information from past failures within the same map unit.

Include the following information in a report on the management unit:

- Slope;
- Landforms;
- Soil/colluvium depth;
- Geology and Materials;
- Hydrologic conditions, i.e., surface and subsurface drainage areas, seasonal condition and amounts;
- Drainage area to potential failure site, i.e., culvert, slide prone area;
- Vegetation type, density, and age;
- Other local factors that have significant associations with stability; and
- Map showing proposed management unit activities.

Explore associations between the variables at the proposed management sites and any past road failures. Consider values of single and grouped stability factors. Develop stability criteria only if there is significant certainty in the association.

Determine and map the hazard level zones, using the following guideline.

If the analysis shows unambiguously that the site is stable, the hazard is low. Proceed with standard Forest Practice Rules. If not, no activity or proceed with analysis of explicit mitigation options to mitigate the potential failure factors. Explicit mitigation is defined as the design and use of specific actions that address the potential impacts to vulnerable public resources. Examples of explicit mitigation for Road Construction include: cross drains, water bars, over-sized culverts, specific road locations, etc, and are subject to DNR approval. Explicit mitigation options will be developed as part of a fully engineered road plan and will mitigate the identified failure factors. If it can not be clearly demonstrated that explicit mitigation can address the stability problems, then the action receives a high hazard rating resulting in no activity or proceed with analysis of explicit mitigation options to mitigate the identified failure factors.

The site-specific mitigation options will be assessed by comparing them to the failure criteria and using a factor of safety analysis. This factor of safety analysis will include an error sensitivity analysis of the stability factors. If the fully engineered road with explicit mitigation addresses the mass wasting unit failure criteria with a low failure hazard determination and has a factor of safety ≥ 1.3 , then the fully engineered road with explicit mitigation may be constructed. If the factor of safety is < 1.3 , the prescription is no activity or proceed with an Alternate Plan forest practice application with a factor of safety analysis.

Shallow Rapid Mass Wasting Flow Chart For Harvest (Figure 2)

The objective of the shallow rapid mass wasting analysis for harvest is to use locally derived data to develop stability criteria within an unstable map unit.

Determine if a failure would deliver sediment to a vulnerable surface water using the mass wasting delivery rating flow chart and associated text. If the failure has a low delivery hazard rating proceed with the hillslope and road surface erosion prescriptions. If the failure has a high or moderate delivery hazard rating, proceed with further assessment.

Collect site-specific information from past failures within same map unit.

Include the following information in a report on the management unit:

- Slope;
- Landforms;
- Soil/colluvium depth;
- Geology and Materials;
- Hydrologic conditions, i.e., surface and subsurface drainage areas, seasonal condition and amounts;
- Drainage area to potential failure site;
- Vegetation type, density, and age;
- Other local factors that have significant associations with stability; and
- Map showing proposed management unit activities.

Explore associations between the variables at the proposed management sites and any past failures. Consider values of single and grouped stability factors. Develop stability criteria only if there is significant certainty in the association.

Determine and map the hazard level zones, using the following guideline.

If the analysis shows unambiguously that the site is stable, the hazard is low. Proceed with standard Forest Practice Rules. If the hazard determination is rated as moderate, then develop explicit mitigation to address the failure factors to reduce the moderate hazard rating to a low rating. This will lead to standard Forest Practice Rules with explicit mitigation. **Examples of Harvest explicit mitigation for harvest are limited harvest, full suspension yarding, etc; and are subject to DNR approval.** If it can not be clearly demonstrated that explicit mitigation can address the stability problems, then the action receives a high hazard rating resulting in no activity or proceed with analysis of explicit mitigation options to mitigate the identified failure factors.

Explicit mitigation options will be developed as part of the harvest plan and will mitigate the identified failure factors. The site-specific mitigation options will be assessed by comparing them to the failure criteria and using a factor of safety analysis. The

factor of safety analysis will include an error sensitivity analysis of the stability factors. If the harvest plan with explicit mitigation addresses the mass wasting unit failure criteria with a low failure hazard determination and has a factor of safety ≥ 1.2 , proceed with the harvest plan. If the factor of safety is < 1.2 , the prescription is no activity or proceed with an Alternate Plan forest practice application with a factor of safety analysis.

Deep Seated Landslide Flow Chart For Roads and Harvest (Figure 3)

The deep-seated landslides analysis is used to predict the response of an existing deep-seated landform to harvest or road construction.

Determine if a failure would deliver sediment to a vulnerable surface water based on assessment of historical aerial photographs and field assessment. If the failure has a low delivery hazard rating, proceed with the hillslope and road surface erosion prescriptions. If the delivery hazard has a high or moderate delivery hazard rating, proceed with further assessment.

Determine the history of deep-seated landslide activity by assessment of a series of aerial photographs and field mapping of relevant vegetation, landform, and geomorphic features. Slide activity is classified into active, dormant, and relic. Active slides have indications of slide mass movement ongoing or indications of motion in the past 50 years (50 years was selected based on the typical age of aerial photographs in the basin). Dormant slides have vegetation, landform, and geomorphic indicators that show they have not moved in the last 50 years. Relic or ancient slides are defined as deep-seated landslide landforms that show a great degree of landform erosion and degradation and other indications of great age. Ancient landslides have no indicators of deep-seated movement in the last 1000 years and appear to be unrelated to the present land forming processes. Typically, landslides, headwalls, and debris deposits, including those of ancient slides, have secondary shallow rapid landslides and erosion hazard areas. Therefore, areas with low delivery hazard are evaluated with the hillslope surface erosion prescriptions, and relic slides are evaluated with the shallow rapid mass wasting flow charts.

Investigate the failure surface and estimated groundwater recharge area. The failure surface of active slides is a no harvest or road construction area or requires an Alternate Plan forest practice application.

Evaluate the estimated groundwater recharge area of presumed dormant slides of deep-seated landslides to estimate if harvest or road construction would activate the slide. Document estimates of the saturated water levels used for the factor of safety analysis.

Mass Wasting Delivery Flow Chart Roads and Harvest (Figure 4)

Introduction

To determine the potential for delivery of landslides, the following delivery rules are prescribed.

Consider topographic conditions at the failure initiation site, along the run-out track, and at the deposition zone for each hypothetical mass failure. The delivery potential is determined at the initiation site. If the run-out and deposition steps show that a public resource will be impacted, the failure is viewed as deliverable. If the failure becomes channelized, it is assumed to become a debris flow deposit. The potential for dam-break floods will be analyzed only if a debris flow or avalanche will be deposited in a channel.

Delivery Runout and Deposition Potential

Hillslopes

Delivery of debris from hillslope or road-related failure is first based on the slope in the initiation area. If the slope gradient is ≤ 20 degrees (36%) the area is classified as low delivery potential; if > 20 degrees (36%) the area is classified as high delivery potential.

Assess material delivered from the hillslope to see if it can continue as a debris flow in the channel. If the channel gradient is ≤ 20 degrees (36%), the area is classified low delivery potential. If the channel gradient is > 20 degrees (36%) the area is classified as high delivery potential.

If the hillslope or road-related failure slope is > 20 and ≤ 30 degrees (58%) and the slope changes to ≤ 20 degrees (36%) for at least 150 feet, add 150 feet of run-out to the deposit area.

If the hillslope is > 30 degrees (58%) and changes to ≤ 20 degrees (36%) for at least 500 feet; add 500 feet of runout to the deposit area.

Debris Flow

If a debris avalanche will enter a channel, test for debris flow initiation.

The potential for deposition from a channel debris flow is based on channel gradient. If the channel gradient is ≥ 3.5 degrees (6.1%) and it changes to ≤ 3.5 degrees (6.1%) for at least 1000 feet; add 1000 feet run-out to the deposition area (the sediment is assumed to deposit).

If the tributary junction angle is > 70 degrees; add 1000 feet run-out to the deposit area and test for dam-break flood. If the tributary junction angle is ≤ 70 degrees, debris is assumed to continue to be delivered downstream.

Dam-Break Flood

If a debris avalanche deposits in a channel, test for dam-break flood initiation.

Apply only after debris avalanche or debris flow deposition. Initiation potential of a dam-break flood is low if any of the following apply:

- Channel gradient < 2 degrees or > 20 degrees (3%);
- Channel width > 65 feet, low delivery potential;
- Channel wall < 6 feet high;
- Otherwise Dam Break initiation potential is high;

Next test for dam-break flood initiation based on channel confinement (confinement is ratio of valley to channel widths). If the confinement is ≥ 5 ; add 1000 feet run-out to the deposition area.

Channel dam-break flood runout is based on channel gradient and confinement. If channel gradient is < 2 degrees (3%), deposition will occur. If channel gradient is ≥ 2 degrees (3%), the dam-break flood continues down stream.

If channel confinement (confinement is ratio of valley to channel widths) is > 10 deposition will occur. If channel confinement is ≤ 10 ; the debris continues to deliver downstream.

References

- Benda, L., and T.W. Cundy, 1990, Predicting Deposition of Debris Flows in Mountain Channels, Canadian Technical Journal, No. 27, p. 409-417.
- Coho, C., and S.J. Burges, 1991, Analysis of Initiation Mechanisms of Dam-break Floods, in Managed Forests, Report to CMER, TFW.
- Kennard, P., 1993 Unpublished Mass Wasting Technical Support for the Tolt Prescription Team, 19pp.

FIGURE 1. SHALLOW RAPID MASS WASTING FLOW CHART FOR ROAD CONSTRUCTION

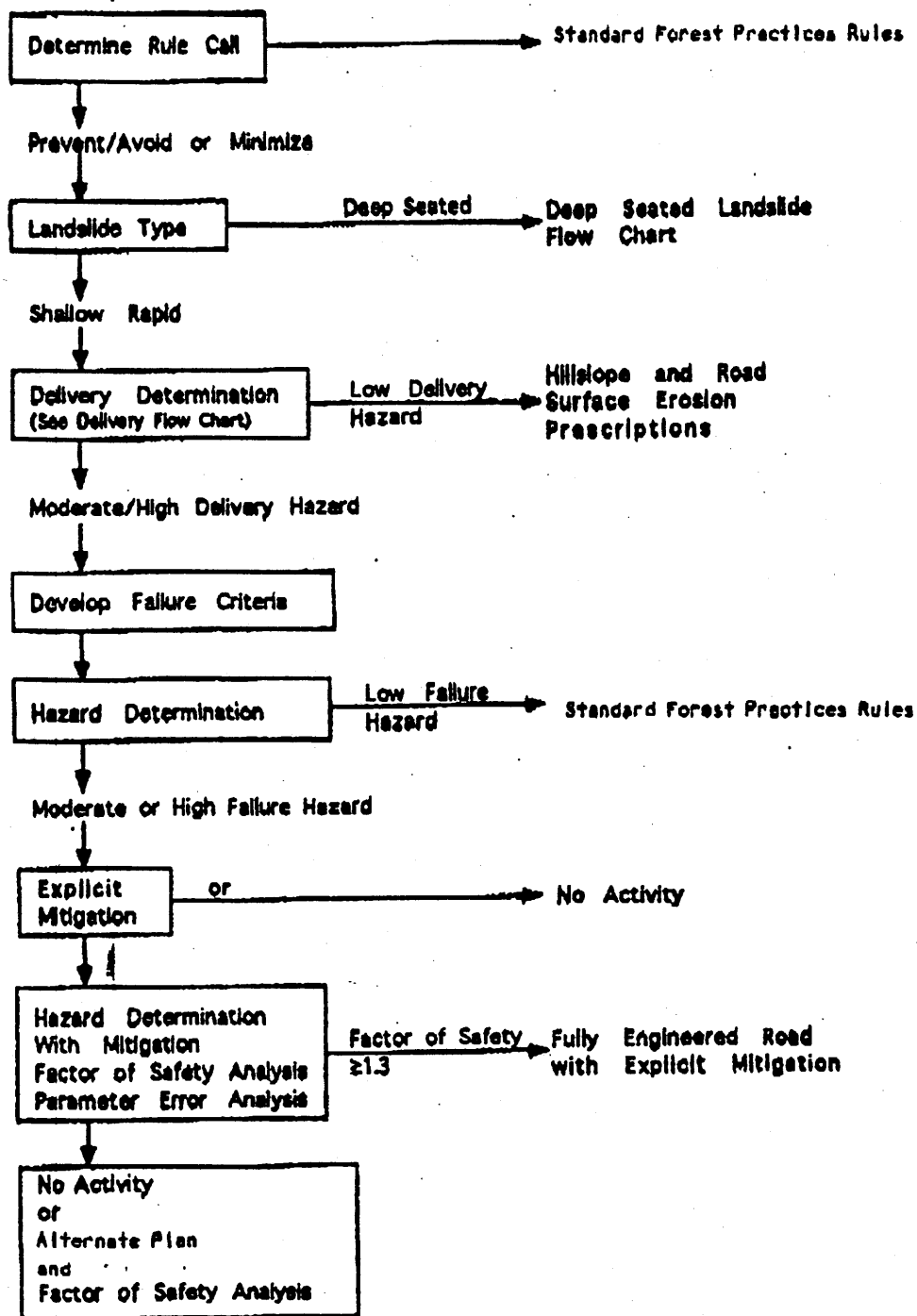


FIGURE 2. SHALLOW RAPID MASS WASTING FLOW CHART FOR HARVEST

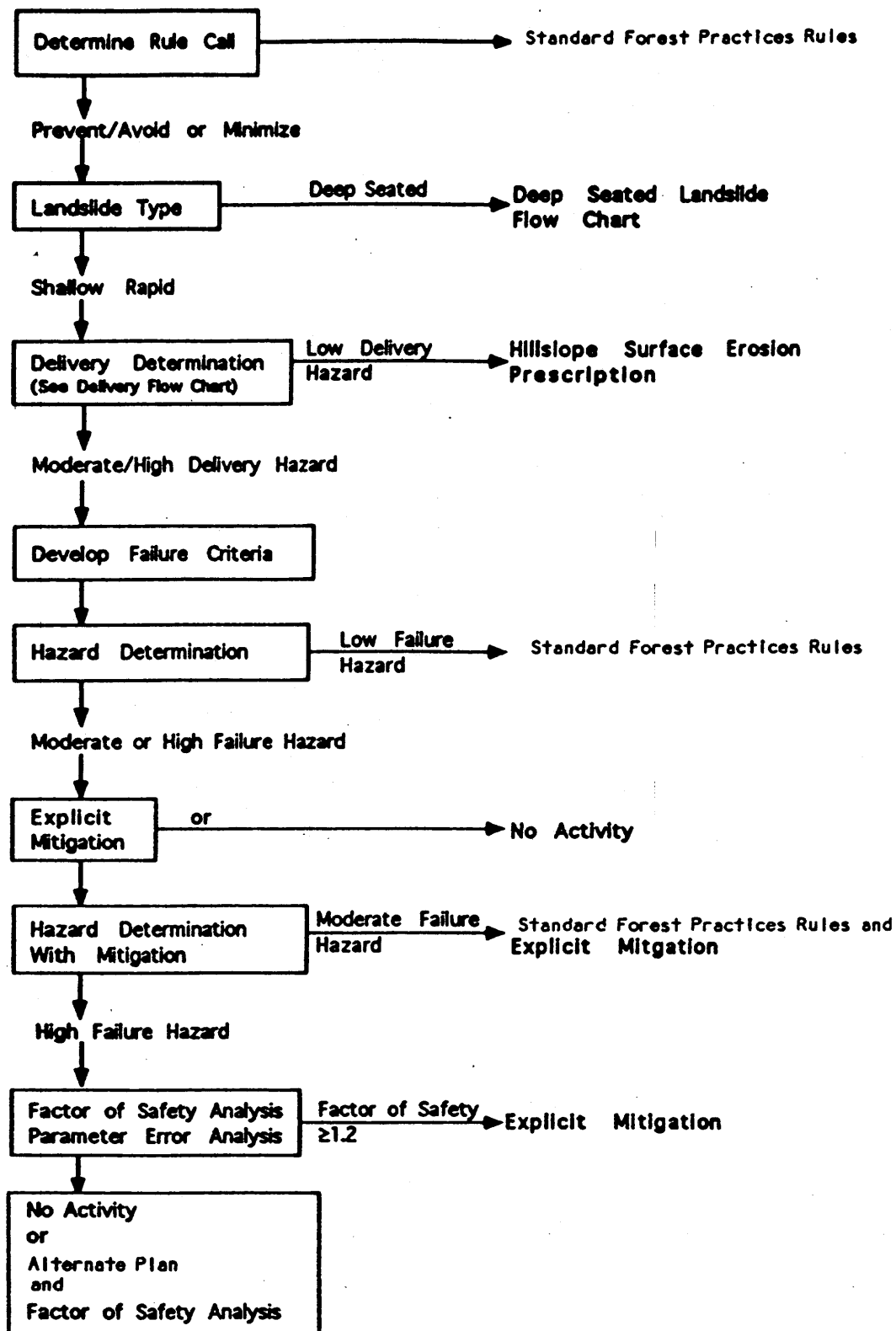


FIGURE 3. DEEP SEATED LANDSLIDE FLOW CHART ROADS AND HARVEST

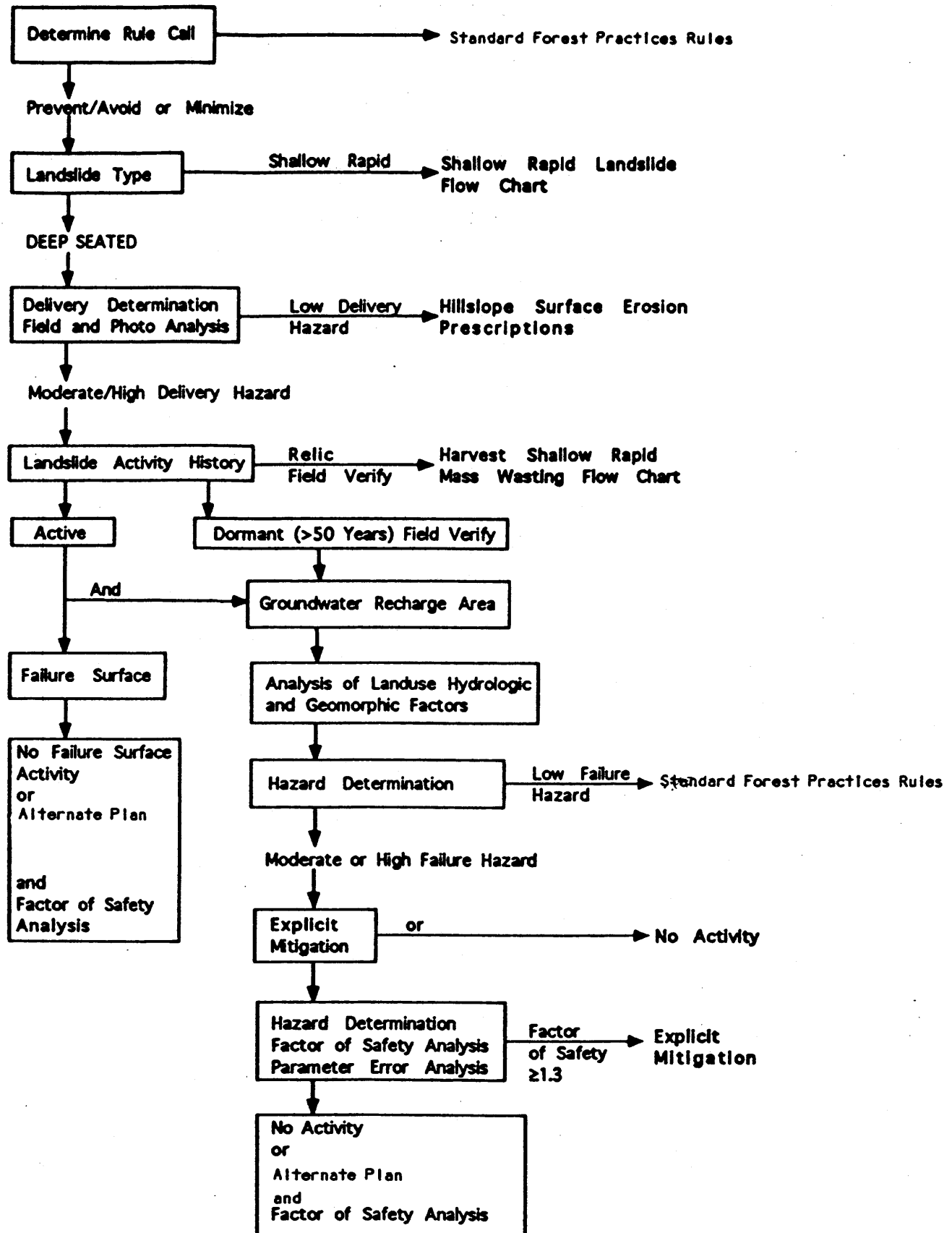
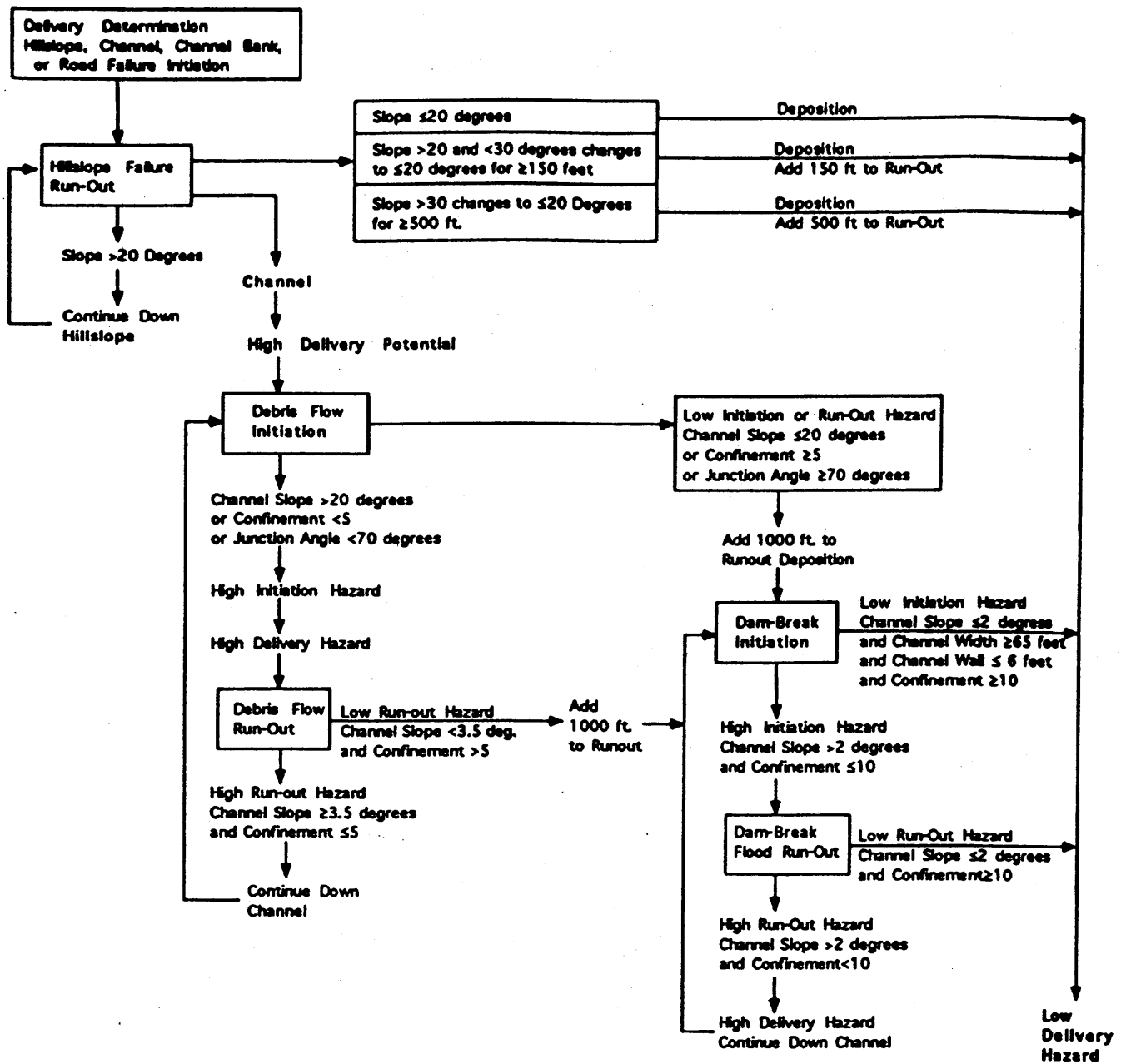
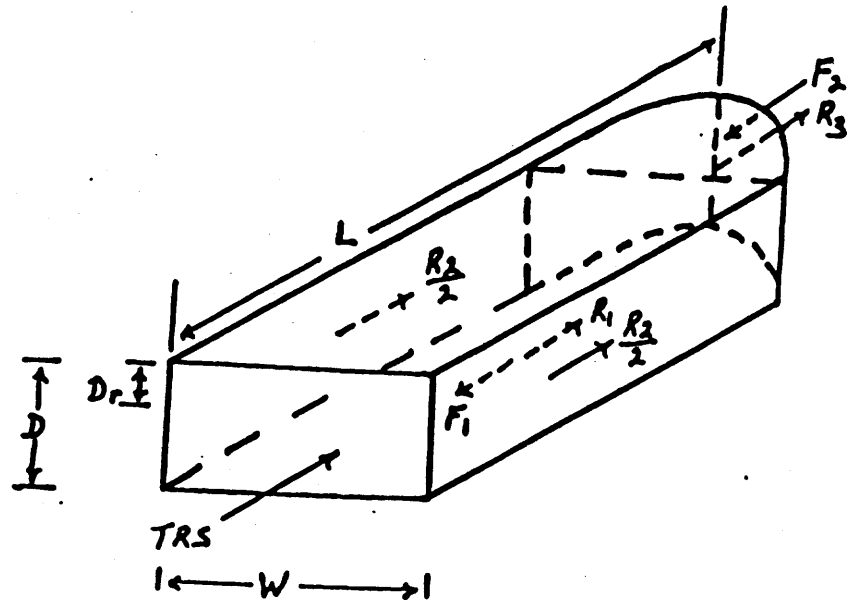


FIGURE 4. MASS WASTING DELIVERY FLOW CHART HILLSLOPE AND ROADS



Factor of Safety Model Critical Point and Block



$$\text{Factor of Safety} = FS = \frac{R1 + R2 + R3 + TRS}{F1 + F2}$$

R1 = Resisting force due to soil shear strength acting on the block base.

R2 = Resisting force due to soil shear strength and root strength acting on the block sides.

R3 = Resisting force due to root strength acting on the upper end of the block.

TRS = Resisting force due to the passive support of the soil-alder root mass at the lower end of the block.

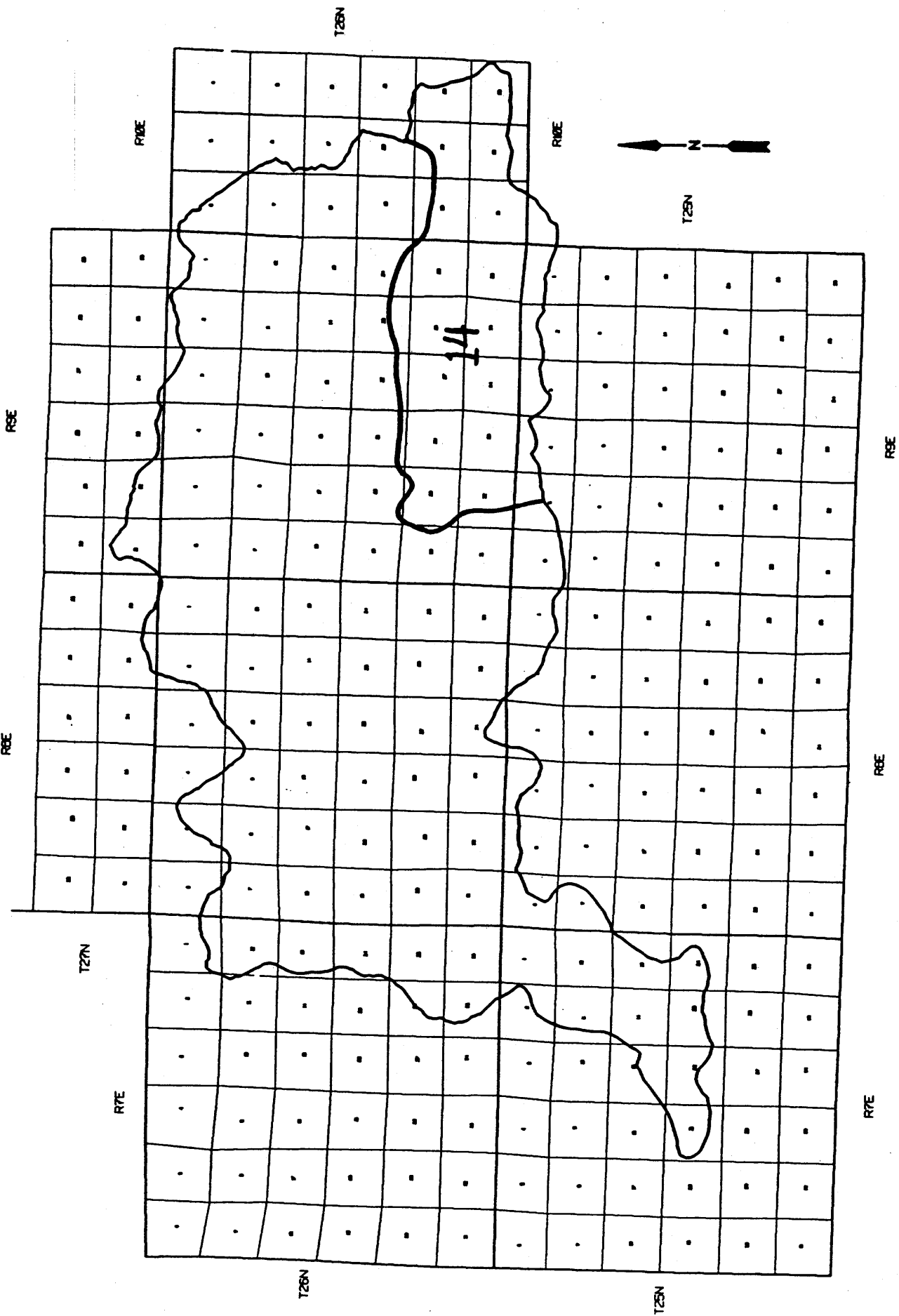
F1 = Driving force due to the weight of the soil and water in the block acting downslope.

F2 = Driving force due to the active soil force acting on the upper block end.

WATER QUALITY

SUB-BASINS 8,9

TOLT WATER QUALITY



Form 3-1. Prescription-Writing Worksheet

WAU:TOLT

Resource Sensitivity Number:

South Fork Tolt Reservoir Basin (Block 14)

(Refer to Tolt Water Quality Map)

Situation Sentence for the Area (from causal mechanism report):

Dissolved organic carbon (DOC) input from natural decomposition of organic matter located throughout the watershed surrounding the South Fork Tolt Reservoir is increased due to high loading of slash and debris (in association with clearcut logging) in channels and on well-drained soils, which increases the disinfection byproduct concentration and degradation of the Seattle drinking water supply.

Triggering Mechanism (from causal mechanism report):

Increased loading of slash and debris from clearcut logging has increased the amount of organic matter available for decomposition. The high loading of slash and debris in stream channels as a result of old felling and yarding activities near streams provided a more direct routing of organic matter and DOC to the reservoir. The reduction of large woody debris in channels as a result of riparian harvest has reduced the retention capacity of streams and increased the routing of organic matter to the reservoir. The removal of forest vegetation decreases evapotranspiration, providing more water for leaching and flushing of DOC from forest soils. This flushing in combination with high loading of slash and debris in a harvest unit increases the potential for routing of DOC into groundwater and to the reservoir.

Rule Call for Management Prescriptions (from causal mechanism report): No formal hazard evaluation has been developed for DOC at this time. Because the relative effectiveness of management activities is not clearly defined at this time, we recommend that forest practices be designed to minimize the production and routing of DOC to the reservoir. Monitoring is strongly recommended to determine the effect of management prescriptions.

Field Observations:

Prescriptions:

Minimize accumulation of loose, unstable, or floatable slash and woody debris in all flowing waters. Follow Forest Practice Board Manual for clearing slash and debris from Type 4 and 5 streams. Apply Surface Erosion Prescription to stream reaches covered by those prescriptions to avoid accumulations of slash and woody debris within stream banks, and to maintain non merchantable trees and understory vegetation.

Voluntary Prescription:

Landowner elects to work cooperatively with affected Indian tribes and appropriate state agencies to evaluate the need and opportunity for sustainable LOD recruitment in type 4, 5, and untyped waters to maintain channel structure and sediment retention.

Justification for Prescriptions:

Reduces the amount of organic matter available for decomposition. Reduces the potential loss of retention mechanism in channels by maintaining large woody debris and decreases the routing of organic matter to the reservoir. Retaining forest vegetation will increase evapotranspiration, reducing water for leaching and flushing of DOC from forest soils. Mass Wasting and Surface Erosion prescriptions will address triggering mechanisms.

SUB-BASINS 1-6

Regional Flood Frequency Worksheet for Tolt River
basins 1,2,3,4,5,6
based on Region I

Recurrence Interval	Regress constant	Area (mi ²)	Area exponent	Ann Precip (in)	Precip exponent	Forest cover	For Cover exponent
2	0.191	41.21	0.86	94.00	1.51	1.00	1.00
5	0.257	41.21	0.86	94.00	1.53	1.00	1.00
10	0.288	41.21	0.85	94.00	1.54	1.00	1.00
25	0.317	41.21	0.85	94.00	1.56	1.00	1.00
50	0.332	41.21	0.86	94.00	1.58	1.00	1.00
100	0.343	41.21	0.86	94.00	1.60	1.00	1.00

Basins 1,2,3,4,5,6

est t3/s)	Standard error (%)	Q + SE
,460.62	24.90	5,571.32
,572.91	24.60	8,189.85
,426.74	26.90	9,424.53
,952.15	31.50	11,772.08
,656.61	35.70	14,461.02
,056.96	40.30	16,915.91

Level 1 Analysis
Sub-basins 1-6

INPUT INFORMATION

Return Period	Peak Flow (cfs)	24-hour Rainfall (in)	Regress. Peak Flow (cfs)
2	4461.00	5.00	4584.08
5	6573.00	6.00	6393.88
10	7427.00	6.50	7298.78
25	8952.00	7.50	9108.58
50	10657.00	8.50	10918.38
100	12057.00	9.00	11823.28

Regression intercept = -4464.92
Regression slope = 1809.80

Elevation of Zones

=====

Elevation of Lowland =	500 (ft)
Elevation of Rain Dominated =	1100 (ft)
Elevation of Rain on Snow =	2250 (ft)
Elevation of Snow Dominated =	3400 (ft)
Elevation of Highland =	4500 (ft)

Snow Water Equivalent vs Elevation Relationship

=====

Constant =	-3.970 (cm)
Slope =	0.042 (cm/m)
Standard Error =	11.278 (cm)

Air Temperature vs Elevation Relationship

=====

Constant =	8.100 (C)
Slope =	-0.006 (C/m)
Standard Error =	2.000 (C)

Wind Speed

=====

Average Wind Speed =	4 (m/s)
Unusual Wind Speed =	7 (m/s)

Level 1 Analysis

SUMMARY INFORMATION

Basin Score = 4.6764984

Worst Basin Score = 9.0366607

Best Basin Score = 2.2591651

Area in Lowland	0	0.00
Area in Rain Dominated	5799	0.22
Area in Rain on Snow	9757	0.37
Area in Snow Dominated	7900	0.30
Area in Highland	2921	0.11
=====		
TOTAL =	26377	1

Area in Large Dense	1494	0.06
Area in Small Dense	12409	0.47
Area in Sparse	7217	0.27
Area in Open	2879	0.11
Area in Non-Forest	2312	0.09
Area in Water	66	0.00
=====		
TOTAL =	26377	1

1 Analysis

Precip Zone- Veg Class	Area (acres)	Precip- Veg Score	Score X Area	P2	P5	P10	P25
L-LD	0.00	1.00	0.00	5.00	6.00	6.50	7.50
L-SD	0.00	1.00	0.00	5.00	6.00	6.50	7.50
L-S	0.00	3.00	0.00	5.00	6.00	6.50	7.50
L-O	0.00	4.00	0.00	5.00	6.00	6.50	7.50
L-NF	0.00	4.00	0.00	5.00	6.00	6.50	7.50
L-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
R-LD	16.00	2.00	32.00	5.00	6.00	6.50	7.50
R-SD	3725.00	2.00	7450.00	5.00	6.00	6.50	7.50
R-S	953.00	6.00	5718.00	5.00	6.00	6.50	7.50
R-O	822.00	8.00	6576.00	5.00	6.00	6.50	7.50
R-NF	237.00	8.00	1896.00	5.00	6.00	6.50	7.50
R-W	46.00	0.00	0.00	5.00	6.00	6.50	7.50
RS-LD	248.00	3.00	744.00	5.00	6.00	6.50	7.50
RS-SD	5334.00	3.00	16002.00	5.00	6.00	6.50	7.50
RS-S	3345.00	9.00	30105.00	5.00	6.00	6.50	7.50
RS-O	457.00	12.00	5484.00	5.00	6.00	6.50	7.50
RS-F	367.00	12.00	4404.00	5.00	6.00	6.50	7.50
RS-W	6.00	0.00	0.00	5.00	6.00	6.50	7.50
S-LD	883.00	2.00	1766.00	5.00	6.00	6.50	7.50
S-SD	2655.00	2.00	5310.00	5.00	6.00	6.50	7.50
S-S	2558.00	6.00	15348.00	5.00	6.00	6.50	7.50
S-O	1153.00	8.00	9224.00	5.00	6.00	6.50	7.50
S-NF	637.00	8.00	5096.00	5.00	6.00	6.50	7.50
S-W	14.00	0.00	0.00	5.00	6.00	6.50	7.50
H-LD	347.00	1.00	347.00	5.00	6.00	6.50	7.50
H-SD	695.00	1.00	695.00	5.00	6.00	6.50	7.50
H-S	361.00	3.00	1083.00	5.00	6.00	6.50	7.50
H-O	447.00	4.00	1788.00	5.00	6.00	6.50	7.50
H-NF	1071.00	4.00	4284.00	5.00	6.00	6.50	7.50
H-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
=====							
TOTAL =	26377.00		123352.00				

[illegible]

SWE MODIFIED CM	AIR TEMP C	SE TEMP C	MODIFIED TEMP C	AVERAGE WIND SPEED M/S	UNUSUAL WIND SPEED M/S	FOREST COVER DECIMAL	MODIFIED AVERAGE WIND M/S
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
27.33	7.19	2.00	9.19	4.00	7.00	0.40	2.72
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
0.00	7.19	2.00	9.19	4.00	7.00	0.00	4.00
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
37.26	6.09	2.00	8.09	4.00	7.00	0.40	2.72
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
0.00	6.09	2.00	8.09	4.00	7.00	0.00	4.00
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
53.87	3.99	2.00	5.99	4.00	7.00	0.40	2.72
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
0.00	3.99	2.00	5.99	4.00	7.00	0.00	4.00
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
63.17	1.88	2.00	3.88	4.00	7.00	0.40	2.72
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.00	4.00
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.40	2.72
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.00	4.00

MODIFIED UNUSUAL WIND M/S	AVERAGE MELT P2 CM	AVERAGE MELT P5 CM	AVERAGE MELT P10 CM	AVERAGE MELT P25 CM	AVERAGE MELT P50 CM	AVERAGE MELT P100 CM	UNUSUAL MELT P2 CM
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
4.76	3.32	3.41	3.46	3.55	3.64	3.68	5.79
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
7.00	4.11	4.20	4.25	4.34	4.43	4.47	7.56
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
4.76	2.85	2.92	2.96	3.04	3.12	3.15	5.13
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
7.00	3.52	3.59	3.63	3.71	3.79	3.82	6.68
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
4.76	1.94	1.99	2.02	2.07	2.12	2.14	3.85
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
7.00	2.38	2.43	2.46	2.51	2.56	2.58	5.01
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
4.76	1.04	1.06	1.07	1.10	1.12	1.13	2.58
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
7.00	1.25	1.27	1.28	1.31	1.33	1.34	3.33
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
4.76	0.17	0.17	0.17	0.17	0.17	0.17	1.36
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
7.00	0.16	0.16	0.16	0.16	0.15	0.15	1.72

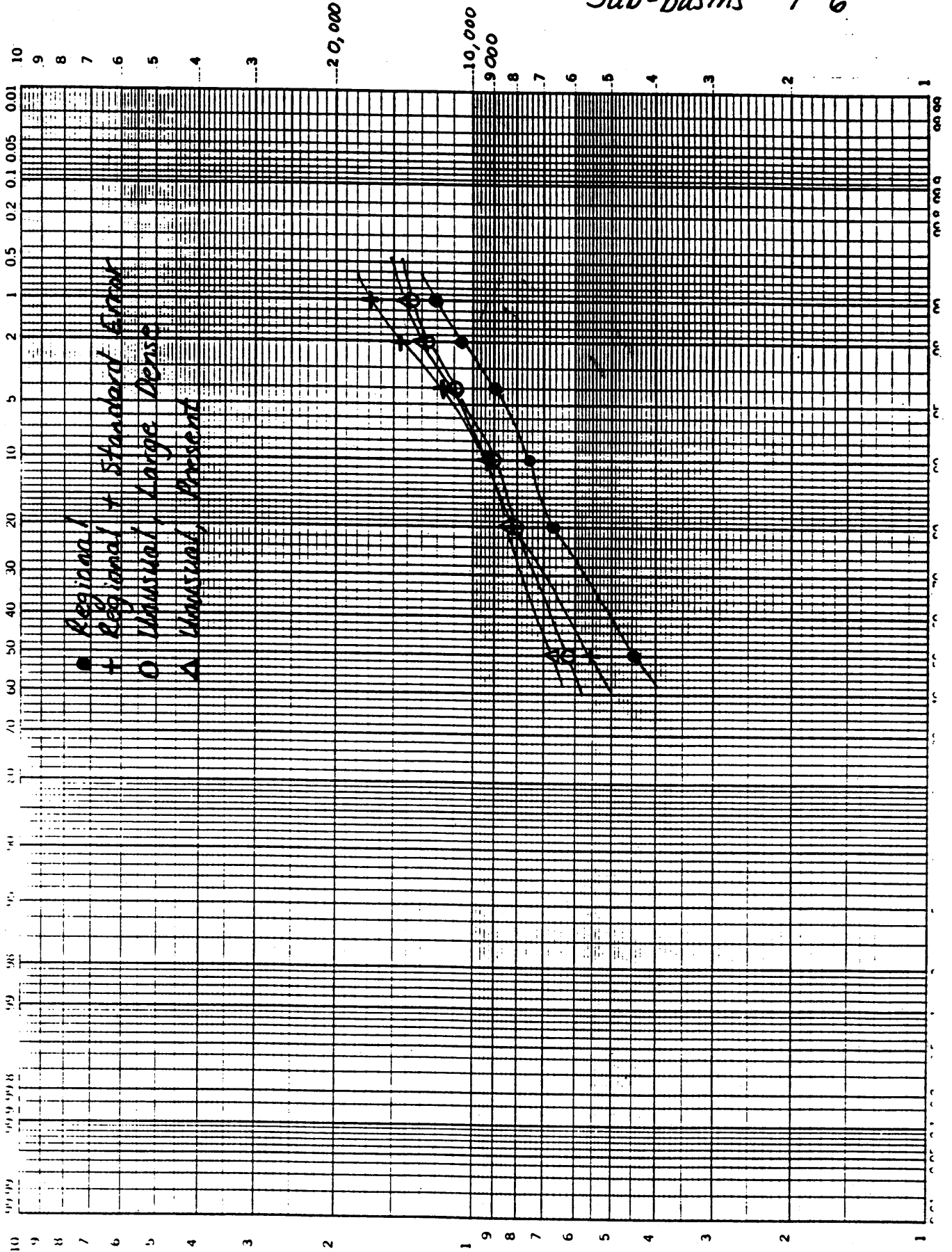
UNUSUAL MELT P5 CM	UNUSUAL MELT P10 CM	UNUSUAL MELT P25 CM	UNUSUAL MELT P50 CM	UNUSUAL MELT P100 CM	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
5.91	5.96	6.08	6.20	6.25	6.31	7.34	7.86
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.68	7.73	7.85	7.97	8.02	6.62	7.65	8.17
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
5.23	5.28	5.38	5.48	5.53	6.12	7.15	7.67
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.79	6.84	6.94	7.04	7.09	6.38	7.42	7.93
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
3.93	3.97	4.04	4.12	4.15	5.77	6.78	7.29
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
5.08	5.12	5.19	5.27	5.31	5.94	6.96	7.47
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
2.63	2.65	2.70	2.75	2.78	5.41	6.42	6.92
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.38	3.40	3.45	3.50	3.52	5.49	6.50	7.00
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
1.39	1.40	1.42	1.45	1.46	5.07	6.07	6.57
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.75	1.76	1.78	1.81	1.82	5.06	6.06	6.56
Average Input =					5.50	6.51	7.02
Peak Flow =					5481.23	7321.21	8241.20

P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN	P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.90	9.93	10.45	7.28	8.33	8.85	9.89	10.94
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.21	10.24	10.76	7.98	9.02	9.54	10.59	11.64
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.70	9.73	10.24	7.02	8.06	8.58	9.62	10.66
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.96	9.99	10.51	7.63	8.67	9.19	10.23	11.27
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.31	9.33	9.84	6.52	7.55	8.06	9.09	10.12
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.49	9.51	10.02	6.97	8.00	8.52	9.55	10.57
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.93	8.94	9.45	6.02	7.04	7.54	8.56	9.58
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.01	9.02	9.53	6.31	7.33	7.84	8.86	9.88
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.54	6.55	7.05	8.06	9.07
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.68	6.69	7.19	8.20	9.21
8.04	9.05	9.56	5.91	6.94	7.45	8.48	9.50
10081.19	11921.18	12841.17	6232.84	8090.78	9019.75	10877.69	12735.63

*****								AREA WEIGHTED		*****	
P100 + UNUSUAL MELT IN	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN	P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN				
10.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
10.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
11.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
12.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
12.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
12.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
10.49	0.00	0.00	0.00	0.00	0.01	0.01	0.01				
10.49	0.82	0.97	1.04	1.19	1.33	1.40	0.89				
11.18	0.22	0.26	0.28	0.31	0.35	0.37	0.25				
11.68	0.20	0.23	0.25	0.28	0.31	0.33	0.23				
11.68	0.06	0.07	0.07	0.08	0.09	0.09	0.07				
11.79	0.01	0.01	0.01	0.02	0.02	0.02	0.01				
10.13	0.05	0.06	0.07	0.08	0.09	0.09	0.06				
10.13	1.13	1.33	1.44	1.64	1.85	1.95	1.21				
10.64	0.73	0.86	0.93	1.05	1.18	1.25	0.83				
11.01	0.10	0.12	0.13	0.15	0.16	0.17	0.12				
11.01	0.08	0.10	0.10	0.12	0.13	0.14	0.10				
11.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
9.76	0.18	0.21	0.23	0.26	0.30	0.31	0.19				
9.76	0.54	0.64	0.69	0.79	0.89	0.94	0.57				
10.09	0.52	0.62	0.67	0.77	0.87	0.92	0.58				
10.34	0.24	0.28	0.31	0.35	0.39	0.42	0.27				
10.34	0.13	0.16	0.17	0.19	0.22	0.23	0.15				
10.39	0.00	0.00	0.00	0.00	0.00	0.01	0.00				
9.41	0.07	0.08	0.09	0.10	0.11	0.12	0.07				
9.41	0.13	0.16	0.17	0.20	0.23	0.24	0.14				
9.57	0.07	0.08	0.09	0.10	0.12	0.12	0.08				
9.69	0.09	0.10	0.11	0.13	0.15	0.15	0.10				
9.69	0.21	0.25	0.27	0.31	0.35	0.37	0.23				
9.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
10.02	5.58	6.60	7.11	8.12	9.14	9.65	6.17				
13664.60	5638.10	7478.09	8398.08	10238.07	12078.05	12998.04	6698.68				

P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN	P100 + UNUSUAL MELT IN
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.01	0.01	0.01
1.04	1.11	1.26	1.41	1.48
0.29	0.31	0.35	0.39	0.40
0.27	0.28	0.32	0.35	0.36
0.08	0.08	0.09	0.10	0.10
0.02	0.02	0.02	0.02	0.02
0.07	0.07	0.08	0.09	0.10
1.42	1.53	1.74	1.94	2.05
0.96	1.02	1.15	1.28	1.35
0.14	0.15	0.16	0.18	0.19
0.11	0.12	0.13	0.15	0.15
0.00	0.00	0.00	0.00	0.00
0.22	0.24	0.28	0.31	0.33
0.67	0.73	0.83	0.93	0.98
0.68	0.73	0.83	0.93	0.98
0.32	0.34	0.38	0.43	0.45
0.18	0.19	0.21	0.24	0.25
0.00	0.00	0.00	0.01	0.01
0.08	0.09	0.10	0.12	0.12
0.17	0.18	0.21	0.23	0.25
0.09	0.10	0.11	0.12	0.13
0.11	0.12	0.14	0.16	0.16
0.27	0.29	0.33	0.37	0.39
0.00	0.00	0.00	0.00	0.00
7.20	7.71	8.73	9.76	10.27
8556.62	9485.59	11343.53	13201.48	14130.45

Sub-basins 1-6



SUB-BASIN 7

Regional Flood Frequency Worksheet for Tolt River
basin 7
based on Region I

Recurrence Interval	Regress constant	Area (mi2)	Area exponent	Ann Precip (in)	Precip exponent	Forest cover	For Cover exponent
2	0.191	5.68	0.86	94.00	1.51	1.00	1.00
5	0.257	5.68	0.86	94.00	1.53	1.00	1.00
10	0.288	5.68	0.85	94.00	1.54	1.00	1.00
25	0.317	5.68	0.85	94.00	1.56	1.00	1.00
50	0.332	5.68	0.86	94.00	1.58	1.00	1.00
100	0.343	5.68	0.86	94.00	1.60	1.00	1.00

basin 7

Q est ft3/s)	Standard error (%)	Q + SE
810.90	24.90	1,012.82
1,194.90	24.60	1,488.85
1,377.15	26.90	1,747.61
1,660.01	31.50	2,182.92
1,937.29	35.70	2,628.90
2,191.86	40.30	3,075.17

Level 1 Analysis
Sub-basin 7

INPUT INFORMATION

Return Period	Peak Flow (cfs)	24-hour Rainfall (in)	Regress. Peak Flow (cfs)
2	811.00	5.00	843.67
5	1195.00	6.00	1172.47
10	1377.00	6.50	1336.87
25	1660.00	7.50	1665.67
50	1937.00	8.50	1994.46
100	2192.00	9.00	2158.86

Regression intercept = -800.31
Regression slope = 328.80

Elevation of Zones

=====

Elevation of Lowland =	500 (ft)
Elevation of Rain Dominated =	1100 (ft)
Elevation of Rain on Snow =	2250 (ft)
Elevation of Snow Dominated =	3400 (ft)
Elevation of Highland =	4500 (ft)

Snow Water Equivalent vs Elevation Relationship

=====

Constant =	-3.970 (cm)
Slope =	0.042 (cm/m)
Standard Error =	11.278 (cm)

Air Temperature vs Elevation Relationship

=====

Constant =	8.100 (C)
Slope =	-0.006 (C/m)
Standard Error =	2.000 (C)

Wind Speed

=====

Average Wind Speed =	4 (m/s)
Unusual Wind Speed =	7 (m/s)

Level 1 Analysis

SUMMARY INFORMATION

Basin Score = 4.6259289

Worst Basin Score = 7.4957335

Best Basin Score = 1.8739333

Area in Lowland	458	0.13
Area in Rain Dominated	3175	0.87
Area in Rain on Snow	0	0.00
Area in Snow Dominated	0	0.00
Area in Highland	0	0.00
=====		
TOTAL =	3633	1

Area in Large Dense	2	0.00
Area in Small Dense	1601	0.44
Area in Sparse	565	0.16
Area in Open	1268	0.35
Area in Non-Forest	184	0.05
Area in Water	13	0.00
=====		
TOTAL =	3633	1

1 Analysis

Precip Zone- Veg Class	Area (acres)	Precip- Veg Score	Score X Area	P2	P5	P10	P25
-LD	0.00	1.00	0.00	5.00	6.00	6.50	7.50
-SD	102.00	1.00	102.00	5.00	6.00	6.50	7.50
-S	88.00	3.00	264.00	5.00	6.00	6.50	7.50
-O	197.00	4.00	788.00	5.00	6.00	6.50	7.50
-NF	63.00	4.00	252.00	5.00	6.00	6.50	7.50
-W	8.00	0.00	0.00	5.00	6.00	6.50	7.50
-LD	2.00	2.00	4.00	5.00	6.00	6.50	7.50
-SD	1499.00	2.00	2998.00	5.00	6.00	6.50	7.50
-S	477.00	6.00	2862.00	5.00	6.00	6.50	7.50
-O	1071.00	8.00	8568.00	5.00	6.00	6.50	7.50
-NF	121.00	8.00	968.00	5.00	6.00	6.50	7.50
-W	5.00	0.00	0.00	5.00	6.00	6.50	7.50
S-LD	0.00	3.00	0.00	5.00	6.00	6.50	7.50
S-SD	0.00	3.00	0.00	5.00	6.00	6.50	7.50
S-S	0.00	9.00	0.00	5.00	6.00	6.50	7.50
O	0.00	12.00	0.00	5.00	6.00	6.50	7.50
?	0.00	12.00	0.00	5.00	6.00	6.50	7.50
RS-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
S-LD	0.00	2.00	0.00	5.00	6.00	6.50	7.50
S-SD	0.00	2.00	0.00	5.00	6.00	6.50	7.50
S-S	0.00	6.00	0.00	5.00	6.00	6.50	7.50
S-O	0.00	8.00	0.00	5.00	6.00	6.50	7.50
S-NF	0.00	8.00	0.00	5.00	6.00	6.50	7.50
S-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
H-LD	0.00	1.00	0.00	5.00	6.00	6.50	7.50
H-SD	0.00	1.00	0.00	5.00	6.00	6.50	7.50
H-S	0.00	3.00	0.00	5.00	6.00	6.50	7.50
H-O	0.00	4.00	0.00	5.00	6.00	6.50	7.50
H-NF	0.00	4.00	0.00	5.00	6.00	6.50	7.50
H-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
TOTAL =	3633.00		16806.00				

[illegible]

SWE MODIFIED CM	AIR TEMP C	SE TEMP C	MODIFIED TEMP C	AVERAGE WIND SPEED M/S	UNUSUAL WIND SPEED M/S	FOREST COVER DECIMAL	MODIFIED AVERAGE WIND M/S
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
27.33	7.19	2.00	9.19	4.00	7.00	0.40	2.72
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
0.00	7.19	2.00	9.19	4.00	7.00	0.00	4.00
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
37.26	6.09	2.00	8.09	4.00	7.00	0.40	2.72
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
0.00	6.09	2.00	8.09	4.00	7.00	0.00	4.00
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
53.87	3.99	2.00	5.99	4.00	7.00	0.40	2.72
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
0.00	3.99	2.00	5.99	4.00	7.00	0.00	4.00
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
63.17	1.88	2.00	3.88	4.00	7.00	0.40	2.72
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.00	4.00
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.40	2.72
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.00	4.00

MODIFIED UNUSUAL WIND M/S	AVERAGE MELT P2 CM	AVERAGE MELT P5 CM	AVERAGE MELT P10 CM	AVERAGE MELT P25 CM	AVERAGE MELT P50 CM	AVERAGE MELT P100 CM	UNUSUAL MELT P2 CM
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
4.76	3.32	3.41	3.46	3.55	3.64	3.68	5.79
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
7.00	4.11	4.20	4.25	4.34	4.43	4.47	7.56
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
4.76	2.85	2.92	2.96	3.04	3.12	3.15	5.13
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
7.00	3.52	3.59	3.63	3.71	3.79	3.82	6.68
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
4.76	1.94	1.99	2.02	2.07	2.12	2.14	3.85
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
7.00	2.38	2.43	2.46	2.51	2.56	2.58	5.01
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
4.76	1.04	1.06	1.07	1.10	1.12	1.13	2.58
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
7.00	1.25	1.27	1.28	1.31	1.33	1.34	3.33
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
4.76	0.17	0.17	0.17	0.17	0.17	0.17	1.36
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
7.00	0.16	0.16	0.16	0.16	0.15	0.15	1.72

UNUSUAL MELT P5 CM	UNUSUAL MELT P10 CM	UNUSUAL MELT P25 CM	UNUSUAL MELT P50 CM	UNUSUAL MELT P100 CM	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
5.91	5.96	6.08	6.20	6.25	6.31	7.34	7.86
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.68	7.73	7.85	7.97	8.02	6.62	7.65	8.17
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
5.23	5.28	5.38	5.48	5.53	6.12	7.15	7.67
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.79	6.84	6.94	7.04	7.09	6.38	7.42	7.93
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
3.93	3.97	4.04	4.12	4.15	5.77	6.78	7.29
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
5.08	5.12	5.19	5.27	5.31	5.94	6.96	7.47
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
2.63	2.65	2.70	2.75	2.78	5.41	6.42	6.92
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.38	3.40	3.45	3.50	3.52	5.49	6.50	7.00
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
1.39	1.40	1.42	1.45	1.46	5.07	6.07	6.57
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.75	1.76	1.78	1.81	1.82	5.06	6.06	6.56
Average Input =					5.84	6.87	7.39
Peak Flow =					1120.16	1459.11	1628.59

P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN	P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.90	9.93	10.45	7.28	8.33	8.85	9.89	10.94
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.21	10.24	10.76	7.98	9.02	9.54	10.59	11.64
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.70	9.73	10.24	7.02	8.06	8.58	9.62	10.66
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.96	9.99	10.51	7.63	8.67	9.19	10.23	11.27
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.31	9.33	9.84	6.52	7.55	8.06	9.09	10.12
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.49	9.51	10.02	6.97	8.00	8.52	9.55	10.57
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.93	8.94	9.45	6.02	7.04	7.54	8.56	9.58
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.01	9.02	9.53	6.31	7.33	7.84	8.86	9.88
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.54	6.55	7.05	8.06	9.07
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.68	6.69	7.19	8.20	9.21
8.42	9.45	9.96	6.35	7.39	7.91	8.95	9.99
1967.54	2306.49	2475.97	1287.32	1629.54	1800.64	2142.86	2485.07

*****								AREA WEIGHTED	*****	
P100 + UNUSUAL MELT IN	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN	P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN			
10.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
10.68	0.17	0.20	0.21	0.24	0.27	0.28	0.18			0.18
11.46	0.15	0.18	0.19	0.22	0.24	0.25	0.18			0.18
12.04	0.36	0.41	0.44	0.50	0.55	0.58	0.43			0.43
12.04	0.11	0.13	0.14	0.16	0.18	0.19	0.14			0.14
12.16	0.01	0.02	0.02	0.02	0.02	0.02	0.02			0.02
10.49	0.00	0.00	0.00	0.00	0.01	0.01	0.00			0.00
10.49	2.40	2.83	3.04	3.47	3.89	4.10	2.61			2.61
11.18	0.80	0.94	1.01	1.14	1.28	1.34	0.92			0.92
11.68	1.87	2.17	2.32	2.63	2.93	3.08	2.22			2.22
11.68	0.21	0.25	0.26	0.30	0.33	0.35	0.25			0.25
11.79	0.01	0.01	0.01	0.01	0.01	0.01	0.01			0.01
10.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
10.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
10.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
11.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
11.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
11.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
9.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
9.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
10.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
10.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
10.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
10.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
9.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
9.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
9.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
9.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
9.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
9.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00
10.51	6.10	7.13	7.65	8.68	9.71	10.23	6.95			6.95
2656.18	1206.29	1545.25	1714.72	2053.68	2392.63	2562.11	1486.03			

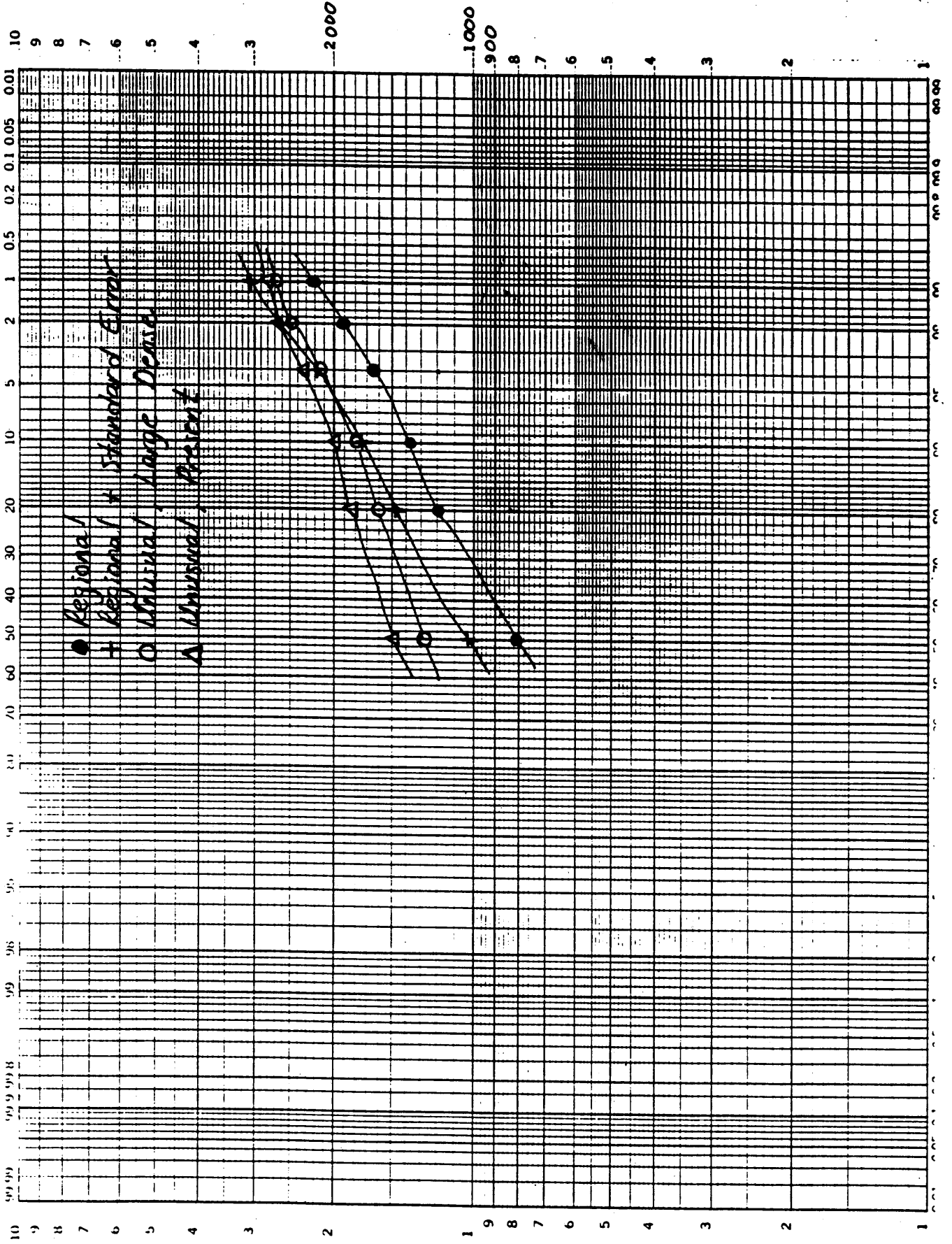
P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN	P100 + UNUSUAL MELT IN
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9
10	10	10	10	10
11	11	11	11	11
12	12	12	12	12
13	13	13	13	13
14	14	14	14	14
15	15	15	15	15
16	16	16	16	16
17	17	17	17	17
18	18	18	18	18
19	19	19	19	19
20	20	20	20	20
21	21	21	21	21
22	22	22	22	22
23	23	23	23	23
24	24	24	24	24
25	25	25	25	25
26	26	26	26	26
27	27	27	27	27
28	28	28	28	28
29	29	29	29	29
30	30	30	30	30
31	31	31	31	31
32	32	32	32	32
33	33	33	33	33
34	34	34	34	34
35	35	35	35	35
36	36	36	36	36
37	37	37	37	37
38	38	38	38	38
39	39	39	39	39
40	40	40	40	40
41	41	41	41	41
42	42	42	42	42
43	43	43	43	43
44	44	44	44	44
45	45	45	45	45
46	46	46	46	46
47	47	47	47	47
48	48	48	48	48
49	49	49	49	49
50	50	50	50	50
51	51	51	51	51
52	52	52	52	52
53	53	53	53	53
54	54	54	54	54
55	55	55	55	55
56	56	56	56	56
57	57	57	57	57
58	58	58	58	58
59	59	59	59	59
60	60	60	60	60
61	61	61	61	61
62	62	62	62	62
63	63	63	63	63
64	64	64	64	64
65	65	65	65	65
66	66	66	66	66
67	67	67	67	67
68	68	68	68	68
69	69	69	69	69
70	70	70	70	70
71	71	71	71	71
72	72	72	72	72
73	73	73	73	73
74	74	74	74	74
75	75	75	75	75
76	76	76	76	76
77	77	77	77	77
78	78	78	78	78
79	79	79	79	79
80	80	80	80	80
81	81	81	81	81
82	82	82	82	82
83	83	83	83	83
84	84	84	84	84
85	85	85	85	85
86</				

0.00	0.00	0.00	0.00	0.00
0.21	0.23	0.26	0.29	0.30
0.20	0.21	0.24	0.26	0.28
0.48	0.51	0.57	0.62	0.65
0.15	0.16	0.18	0.20	0.21
0.02	0.02	0.02	0.03	0.03
0.00	0.00	0.00	0.01	0.01
3.04	3.25	3.68	4.11	4.33
1.06	1.13	1.26	1.40	1.47
2.52	2.68	2.98	3.29	3.44
0.29	0.30	0.34	0.37	0.39
0.01	0.01	0.01	0.02	0.02
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
7.99	8.51	9.56	10.60	11.12
1828.25	1999.35	2341.57	2683.78	2854.89

Sub-basin 7

46 8040

16.2 PROBABILITY & FREQUENCY



Regional Flood Frequency Worksheet for Tolt River
 Sub-basins 8,9
 based on Region I

Recurrence Interval	Regress constant	Area (mi2)	Area exponent	Ann Precip (in)	Precip exponent	Forest cover	For Cover exponent
2	0.191	18.54	0.86	94.00	1.51	1.00	1.00
5	0.257	18.54	0.86	94.00	1.53	1.00	1.00
10	0.288	18.54	0.85	94.00	1.54	1.00	1.00
25	0.317	18.54	0.85	94.00	1.56	1.00	1.00
50	0.332	18.54	0.86	94.00	1.58	1.00	1.00
100	0.343	18.54	0.86	94.00	1.60	1.00	1.00

Sub-basins 8,9

Q est (ft ³ /s)	Standard error (%)	Q + SE
2,243.62	24.90	2,802.28
3,306.06	24.60	4,119.36
3,765.49	26.90	4,778.41
4,538.90	31.50	5,968.66
5,360.10	35.70	7,273.65
6,064.45	40.30	8,508.42

Level 1 Analysis
Sub-basins 8,9

INPUT INFORMATION

Return Period	Peak Flow (cfs)	24-hour Rainfall (in)	Regress. Peak Flow (cfs)
2	2244.00	5.00	2317.18
5	3306.00	6.00	3227.17
10	3765.00	6.50	3682.17
25	4539.00	7.50	4592.16
50	5360.00	8.50	5502.16
100	6064.00	9.00	5957.15

Regression intercept = -2232.78
Regression slope = 909.99

Elevation of Zones

=====

Elevation of Lowland =	500 (ft)
Elevation of Rain Dominated =	1100 (ft)
Elevation of Rain on Snow =	2250 (ft)
Elevation of Snow Dominated =	3400 (ft)
Elevation of Highland =	4500 (ft)

Snow Water Equivalent vs Elevation Relationship

=====

Constant =	-3.970 (cm)
Slope =	0.042 (cm/m)
Standard Error =	11.278 (cm)

Air Temperature vs Elevation Relationship

=====

Constant =	8.100 (C)
Slope =	-0.006 (C/m)
Standard Error =	2.000 (C)

Wind Speed

=====

Average Wind Speed =	4 (m/s)
Unusual Wind Speed =	7 (m/s)

Level 1 Analysis

SUMMARY INFORMATION

Basin Score = 4.5472477

Worst Basin Score = 8.3786563

Best Basin Score = 2.0946640

Area in Lowland	0	0.00
Area in Rain Dominated	1400	0.12
Area in Rain on Snow	3418	0.29
Area in Snow Dominated	4750	0.40
Area in Highland	2295	0.19
	=====	=====
TOTAL =	11863	1

Area in Large Dense	342	0.03
Area in Small Dense	3967	0.33
Area in Sparse	3614	0.30
Area in Open	1059	0.09
Area in Non-Forest	1817	0.15
Area in Water	1064	0.09
	=====	=====
TOTAL =	11863	1

1 Analysis

Precip Zone- Veg Class	Area (acres)	Precip- Veg Score	Score X Area	P2	P5	P10	P25
-LD	0.00	1.00	0.00	5.00	6.00	6.50	7.50
-SD	0.00	1.00	0.00	5.00	6.00	6.50	7.50
-S	0.00	3.00	0.00	5.00	6.00	6.50	7.50
-O	0.00	4.00	0.00	5.00	6.00	6.50	7.50
-NF	0.00	4.00	0.00	5.00	6.00	6.50	7.50
-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
R-LD	0.00	2.00	0.00	5.00	6.00	6.50	7.50
R-SD	281.00	2.00	562.00	5.00	6.00	6.50	7.50
R-S	52.00	6.00	312.00	5.00	6.00	6.50	7.50
R-O	0.00	8.00	0.00	5.00	6.00	6.50	7.50
R-NF	20.00	8.00	160.00	5.00	6.00	6.50	7.50
R-W	1047.00	0.00	0.00	5.00	6.00	6.50	7.50
RS-LD	9.00	3.00	27.00	5.00	6.00	6.50	7.50
RS-SD	1677.00	3.00	5031.00	5.00	6.00	6.50	7.50
RS-S	1477.00	9.00	13293.00	5.00	6.00	6.50	7.50
RS-S	68.00	12.00	816.00	5.00	6.00	6.50	7.50
RS-F	187.00	12.00	2244.00	5.00	6.00	6.50	7.50
RS-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
S-LD	170.00	2.00	340.00	5.00	6.00	6.50	7.50
S-SD	1437.00	2.00	2874.00	5.00	6.00	6.50	7.50
S-S	1613.00	6.00	9678.00	5.00	6.00	6.50	7.50
S-O	816.00	8.00	6528.00	5.00	6.00	6.50	7.50
S-NF	697.00	8.00	5576.00	5.00	6.00	6.50	7.50
S-W	17.00	0.00	0.00	5.00	6.00	6.50	7.50
H-LD	163.00	1.00	163.00	5.00	6.00	6.50	7.50
H-SD	572.00	1.00	572.00	5.00	6.00	6.50	7.50
H-S	472.00	3.00	1416.00	5.00	6.00	6.50	7.50
H-O	175.00	4.00	700.00	5.00	6.00	6.50	7.50
H-NF	913.00	4.00	3652.00	5.00	6.00	6.50	7.50
H-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
TOTAL =				11863.00	53944.00		

[illegible]

SWE MODIFIED CM	AIR TEMP C	SE TEMP C	MODIFIED TEMP C	AVERAGE WIND SPEED M/S	UNUSUAL WIND SPEED M/S	FOREST COVER DECIMAL	MODIFIED AVERAGE WIND M/S
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
27.33	7.19	2.00	9.19	4.00	7.00	0.40	2.72
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
0.00	7.19	2.00	9.19	4.00	7.00	0.00	4.00
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
37.26	6.09	2.00	8.09	4.00	7.00	0.40	2.72
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
0.00	6.09	2.00	8.09	4.00	7.00	0.00	4.00
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
53.87	3.99	2.00	5.99	4.00	7.00	0.40	2.72
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
0.00	3.99	2.00	5.99	4.00	7.00	0.00	4.00
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
63.17	1.88	2.00	3.88	4.00	7.00	0.40	2.72
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.00	4.00
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.40	2.72
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.00	4.00

MODIFIED UNUSUAL WIND M/S	AVERAGE MELT P2 CM	AVERAGE MELT P5 CM	AVERAGE MELT P10 CM	AVERAGE MELT P25 CM	AVERAGE MELT P50 CM	AVERAGE MELT P100 CM	UNUSUAL MELT P2 CM
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
4.76	3.32	3.41	3.46	3.55	3.64	3.68	5.79
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
7.00	4.11	4.20	4.25	4.34	4.43	4.47	7.56
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
4.76	2.85	2.92	2.96	3.04	3.12	3.15	5.13
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
7.00	3.52	3.59	3.63	3.71	3.79	3.82	6.68
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
4.76	1.94	1.99	2.02	2.07	2.12	2.14	3.85
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
7.00	2.38	2.43	2.46	2.51	2.56	2.58	5.01
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
4.76	1.04	1.06	1.07	1.10	1.12	1.13	2.58
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
7.00	1.25	1.27	1.28	1.31	1.33	1.34	3.33
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
4.76	0.17	0.17	0.17	0.17	0.17	0.17	1.36
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
7.00	0.16	0.16	0.16	0.16	0.15	0.15	1.72

UNUSUAL MELT P5 CM	UNUSUAL MELT P10 CM	UNUSUAL MELT P25 CM	UNUSUAL MELT P50 CM	UNUSUAL MELT P100 CM	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
5.91	5.96	6.08	6.20	6.25	6.31	7.34	7.86
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.68	7.73	7.85	7.97	8.02	6.62	7.65	8.17
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
5.23	5.28	5.38	5.48	5.53	6.12	7.15	7.67
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.79	6.84	6.94	7.04	7.09	6.38	7.42	7.93
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
3.93	3.97	4.04	4.12	4.15	5.77	6.78	7.29
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
5.08	5.12	5.19	5.27	5.31	5.94	6.96	7.47
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
2.63	2.65	2.70	2.75	2.78	5.41	6.42	6.92
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.38	3.40	3.45	3.50	3.52	5.49	6.50	7.00
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
1.39	1.40	1.42	1.45	1.46	5.07	6.07	6.57
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.75	1.76	1.78	1.81	1.82	5.06	6.06	6.56

Average Input = 5.40 6.42 6.92

Peak Flow = 2684.20 3605.91 4066.77

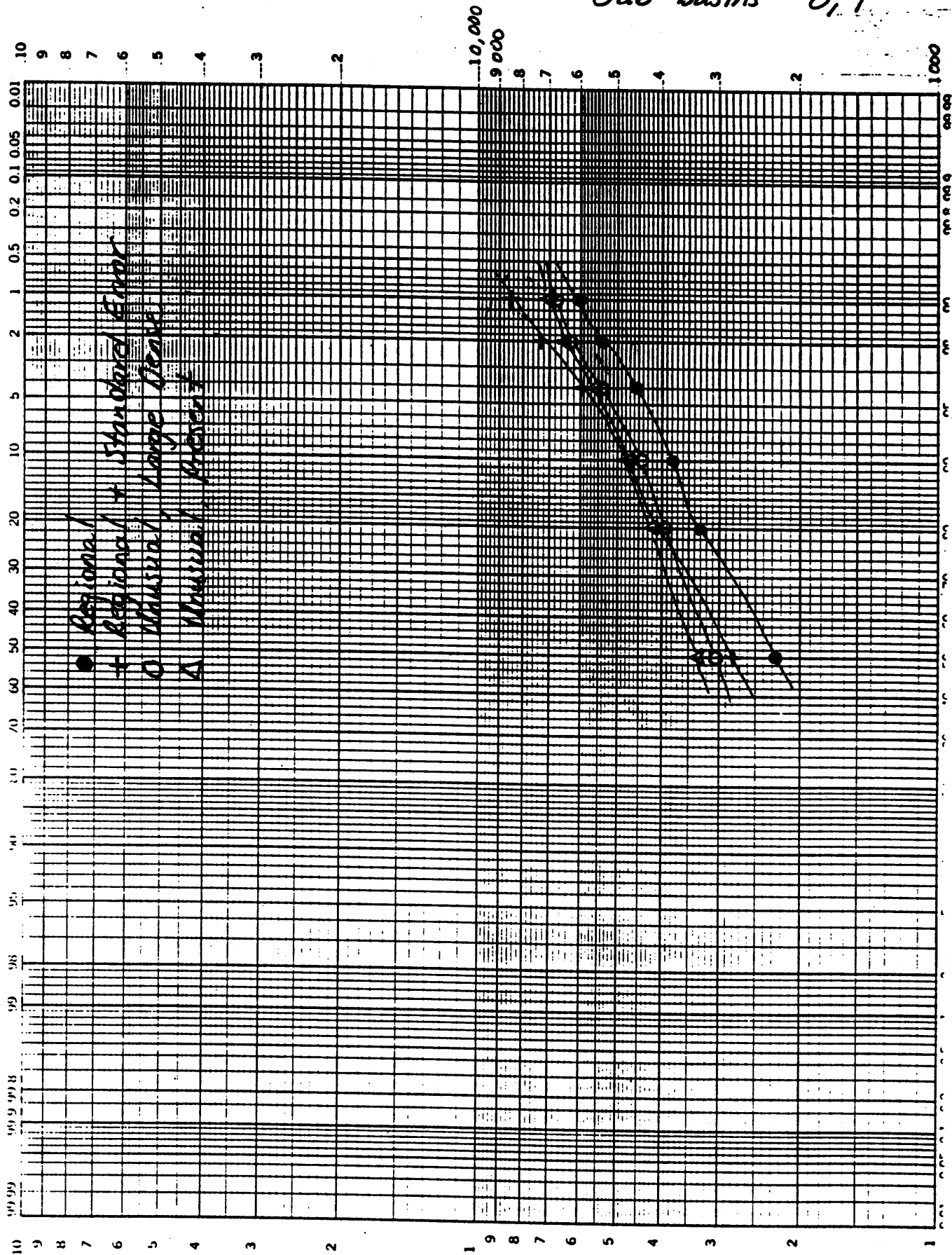
P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN	P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.90	9.93	10.45	7.28	8.33	8.85	9.89	10.94
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.21	10.24	10.76	7.98	9.02	9.54	10.59	11.64
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.70	9.73	10.24	7.02	8.06	8.58	9.62	10.66
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.96	9.99	10.51	7.63	8.67	9.19	10.23	11.27
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.31	9.33	9.84	6.52	7.55	8.06	9.09	10.12
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.49	9.51	10.02	6.97	8.00	8.52	9.55	10.57
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.93	8.94	9.45	6.02	7.04	7.54	8.56	9.58
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.01	9.02	9.53	6.31	7.33	7.84	8.86	9.88
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.54	6.55	7.05	8.06	9.07
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.68	6.69	7.19	8.20	9.21
7.94	8.95	9.45	5.79	6.82	7.33	8.35	9.37
4988.48	5910.18	6371.04	3039.45	3970.18	4435.55	5366.29	6297.03

AREA WEIGHTED

P100 + UNUSUAL MELT IN	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN	P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN
10.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.49	0.14	0.16	0.17	0.20	0.22	0.24	0.15
11.18	0.03	0.03	0.03	0.04	0.04	0.04	0.03
11.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.68	0.01	0.01	0.01	0.02	0.02	0.02	0.01
11.79	0.56	0.65	0.70	0.79	0.88	0.93	0.67
10.13	0.00	0.01	0.01	0.01	0.01	0.01	0.00
10.13	0.79	0.93	1.00	1.15	1.29	1.36	0.85
10.64	0.72	0.84	0.91	1.04	1.16	1.23	0.81
11.01	0.03	0.04	0.04	0.05	0.05	0.06	0.04
11.01	0.09	0.11	0.12	0.13	0.15	0.16	0.11
11.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.76	0.08	0.09	0.10	0.11	0.13	0.13	0.08
9.76	0.64	0.77	0.83	0.95	1.07	1.13	0.69
10.09	0.74	0.87	0.94	1.08	1.22	1.28	0.82
10.34	0.38	0.45	0.48	0.55	0.62	0.65	0.43
10.34	0.32	0.38	0.41	0.47	0.53	0.56	0.37
10.39	0.01	0.01	0.01	0.01	0.01	0.01	0.01
9.41	0.07	0.08	0.09	0.10	0.12	0.12	0.07
9.41	0.24	0.29	0.32	0.37	0.41	0.44	0.26
9.57	0.20	0.24	0.26	0.30	0.34	0.36	0.22
9.69	0.07	0.09	0.10	0.11	0.13	0.13	0.08
9.69	0.39	0.47	0.51	0.58	0.66	0.70	0.44
9.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.88	5.52	6.53	7.04	8.05	9.06	9.57	6.15
6762.40	2788.72	3710.43	4171.28	5092.99	6014.70	6475.55	3361.22

P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN	P100 + UNUSUAL MELT IN
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.17	0.19	0.21	0.24	0.25
0.04	0.04	0.04	0.05	0.05
0.00	0.00	0.00	0.00	0.00
0.01	0.02	0.02	0.02	0.02
0.77	0.81	0.90	0.99	1.04
0.01	0.01	0.01	0.01	0.01
0.99	1.07	1.21	1.36	1.43
0.94	1.00	1.13	1.26	1.32
0.05	0.05	0.05	0.06	0.06
0.12	0.13	0.15	0.17	0.17
0.00	0.00	0.00	0.00	0.00
0.10	0.10	0.12	0.13	0.14
0.81	0.87	1.00	1.12	1.18
0.96	1.03	1.16	1.30	1.37
0.50	0.54	0.61	0.68	0.71
0.43	0.46	0.52	0.58	0.61
0.01	0.01	0.01	0.01	0.01
0.09	0.09	0.11	0.12	0.13
0.31	0.33	0.38	0.43	0.45
0.26	0.28	0.32	0.36	0.38
0.10	0.11	0.12	0.14	0.14
0.51	0.55	0.63	0.71	0.75
0.00	0.00	0.00	0.00	0.00
7.17	7.68	8.70	9.73	10.24
4291.95	4757.32	5688.06	6618.80	7084.17

Sub-basins 8, 9



SUB-BASIN 11

onal Flood Frequency Worksheet for Tolt River
Sub-basin 11
based on Region I

Recurrence Interval	Regress constant	Area (mi2)	Area exponent	Ann Precip (in)	Precip exponent	Forest cover	For Cover exponent
2	0.191	5.28	0.86	94.00	1.51	1.00	1.00
5	0.257	5.28	0.86	94.00	1.53	1.00	1.00
10	0.288	5.28	0.85	94.00	1.54	1.00	1.00
25	0.317	5.28	0.85	94.00	1.56	1.00	1.00
50	0.332	5.28	0.86	94.00	1.58	1.00	1.00
100	0.343	5.28	0.86	94.00	1.60	1.00	1.00

SL basin 11

Q est (ft ³ /s)	Standard error (%)	Q + SE
761.32	24.90	950.89
1,121.84	24.60	1,397.81
1,293.89	26.90	1,641.95
1,559.65	31.50	2,050.94
1,818.83	35.70	2,468.15
2,057.83	40.30	2,887.14

Level 1 Analysis
Sub-basin 11

INPUT INFORMATION

Return Period	Peak Flow (cfs)	24-hour Rainfall (in)	Regress. Peak Flow (cfs)
2	761.00	5.00	792.31
5	1122.00	6.00	1101.12
10	1294.00	6.50	1255.53
25	1560.00	7.50	1564.34
50	1819.00	8.50	1873.15
100	2058.00	9.00	2027.56

Regression intercept = -751.75
Regression slope = 308.81

Elevation of Zones

=====

Elevation of Lowland =	500 (ft)
Elevation of Rain Dominated =	1100 (ft)
Elevation of Rain on Snow =	2250 (ft)
Elevation of Snow Dominated =	3400 (ft)
Elevation of Highland =	4500 (ft)

Snow Water Equivalent vs Elevation Relationship

=====

Constant =	-3.970 (cm)
Slope =	0.042 (cm/m)
Standard Error =	11.278 (cm)

Air Temperature vs Elevation Relationship

=====

Constant =	8.100 (C)
Slope =	-0.006 (C/m)
Standard Error =	2.000 (C)

Wind Speed

=====

Average Wind Speed =	4 (m/s)
Unusual Wind Speed =	7 (m/s)

Level 1 Analysis

SUMMARY INFORMATION

Basin Score = 3.4425355

Worst Basin Score = 8.9004739

Best Basin Score = 2.2251184

Area in Lowland	0	0.00
Area in Rain Dominated	1923	0.57
Area in Rain on Snow	769	0.23
Area in Snow Dominated	675	0.20
Area in Highland	9	0.00
=====		
TOTAL =	3376	1

Area in Large Dense	0	0.00
Area in Small Dense	2624	0.78
Area in Sparse	218	0.06
Area in Open	398	0.12
Area in Non-Forest	136	0.04
Area in Water	0	0.00
=====		
TOTAL =	3376	1

1 1 Analysis

Precip Zone- Veg Class	Area (acres)	Precip- Veg Score	Score X Area	P2	P5	P10	P25
L-LD	0.00	1.00	0.00	5.00	6.00	6.50	7.50
L-SD	0.00	1.00	0.00	5.00	6.00	6.50	7.50
L-S	0.00	3.00	0.00	5.00	6.00	6.50	7.50
L-O	0.00	4.00	0.00	5.00	6.00	6.50	7.50
L-NF	0.00	4.00	0.00	5.00	6.00	6.50	7.50
L-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
R-LD	0.00	2.00	0.00	5.00	6.00	6.50	7.50
R-SD	1270.00	2.00	2540.00	5.00	6.00	6.50	7.50
R-S	121.00	6.00	726.00	5.00	6.00	6.50	7.50
R-O	398.00	8.00	3184.00	5.00	6.00	6.50	7.50
R-NF	134.00	8.00	1072.00	5.00	6.00	6.50	7.50
R-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
RS-LD	0.00	3.00	0.00	5.00	6.00	6.50	7.50
RS-SD	752.00	3.00	2256.00	5.00	6.00	6.50	7.50
RS-S	17.00	9.00	153.00	5.00	6.00	6.50	7.50
R	0.00	12.00	0.00	5.00	6.00	6.50	7.50
R-NF	0.00	12.00	0.00	5.00	6.00	6.50	7.50
RS-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
S-LD	0.00	2.00	0.00	5.00	6.00	6.50	7.50
S-SD	593.00	2.00	1186.00	5.00	6.00	6.50	7.50
S-S	80.00	6.00	480.00	5.00	6.00	6.50	7.50
S-O	0.00	8.00	0.00	5.00	6.00	6.50	7.50
S-NF	2.00	8.00	16.00	5.00	6.00	6.50	7.50
S-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
H-LD	0.00	1.00	0.00	5.00	6.00	6.50	7.50
H-SD	9.00	1.00	9.00	5.00	6.00	6.50	7.50
H-S	0.00	3.00	0.00	5.00	6.00	6.50	7.50
H-O	0.00	4.00	0.00	5.00	6.00	6.50	7.50
H-NF	0.00	4.00	0.00	5.00	6.00	6.50	7.50
H-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
=====				=====			
TOTAL =	3376.00		11622.00				

[illegible]

SWE MODIFIED CM	AIR TEMP C	SE TEMP C	MODIFIED TEMP C	AVERAGE WIND SPEED M/S	UNUSUAL WIND SPEED M/S	FOREST COVER DECIMAL	MODIFIED AVERAGE WIND M/S
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
27.33	7.19	2.00	9.19	4.00	7.00	0.40	2.72
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
0.00	7.19	2.00	9.19	4.00	7.00	0.00	4.00
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
37.26	6.09	2.00	8.09	4.00	7.00	0.40	2.72
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
0.00	6.09	2.00	8.09	4.00	7.00	0.00	4.00
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
53.87	3.99	2.00	5.99	4.00	7.00	0.40	2.72
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
0.00	3.99	2.00	5.99	4.00	7.00	0.00	4.00
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
63.17	1.88	2.00	3.88	4.00	7.00	0.40	2.72
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.00	4.00
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.40	2.72
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.00	4.00

MODIFIED UNUSUAL WIND M/S	AVERAGE MELT P2 CM	AVERAGE MELT P5 CM	AVERAGE MELT P10 CM	AVERAGE MELT P25 CM	AVERAGE MELT P50 CM	AVERAGE MELT P100 CM	UNUSUAL MELT P2 CM
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
4.76	3.32	3.41	3.46	3.55	3.64	3.68	5.79
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
7.00	4.11	4.20	4.25	4.34	4.43	4.47	7.56
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
4.76	2.85	2.92	2.96	3.04	3.12	3.15	5.13
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
7.00	3.52	3.59	3.63	3.71	3.79	3.82	6.68
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
4.76	1.94	1.99	2.02	2.07	2.12	2.14	3.85
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
7.00	2.38	2.43	2.46	2.51	2.56	2.58	5.01
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
4.76	1.04	1.06	1.07	1.10	1.12	1.13	2.58
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
7.00	1.25	1.27	1.28	1.31	1.33	1.34	3.33
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
4.76	0.17	0.17	0.17	0.17	0.17	0.17	1.36
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
7.00	0.16	0.16	0.16	0.16	0.15	0.15	1.72

UNUSUAL MELT P5 CM	UNUSUAL MELT P10 CM	UNUSUAL MELT P25 CM	UNUSUAL MELT P50 CM	UNUSUAL MELT P100 CM	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
5.91	5.96	6.08	6.20	6.25	6.31	7.34	7.86
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.68	7.73	7.85	7.97	8.02	6.62	7.65	8.17
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
5.23	5.28	5.38	5.48	5.53	6.12	7.15	7.67
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.79	6.84	6.94	7.04	7.09	6.38	7.42	7.93
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
3.93	3.97	4.04	4.12	4.15	5.77	6.78	7.29
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
5.08	5.12	5.19	5.27	5.31	5.94	6.96	7.47
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
2.63	2.65	2.70	2.75	2.78	5.41	6.42	6.92
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.38	3.40	3.45	3.50	3.52	5.49	6.50	7.00
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
1.39	1.40	1.42	1.45	1.46	5.07	6.07	6.57
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.75	1.76	1.78	1.81	1.82	5.06	6.06	6.56
Average Input =					5.66	6.69	7.20
Peak Flow =					997.10	1313.19	1471.24

P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN	P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.90	9.93	10.45	7.28	8.33	8.85	9.89	10.94
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.21	10.24	10.76	7.98	9.02	9.54	10.59	11.64
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.70	9.73	10.24	7.02	8.06	8.58	9.62	10.66
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.96	9.99	10.51	7.63	8.67	9.19	10.23	11.27
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.31	9.33	9.84	6.52	7.55	8.06	9.09	10.12
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.49	9.51	10.02	6.97	8.00	8.52	9.55	10.57
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.93	8.94	9.45	6.02	7.04	7.54	8.56	9.58
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.01	9.02	9.53	6.31	7.33	7.84	8.86	9.88
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.54	6.55	7.05	8.06	9.07
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.68	6.69	7.19	8.20	9.21
8.22	9.25	9.76	6.12	7.16	7.67	8.71	9.74
1787.33	2103.42	2261.47	1139.30	1458.46	1618.03	1937.19	2256.34

AREA WEIGHTED

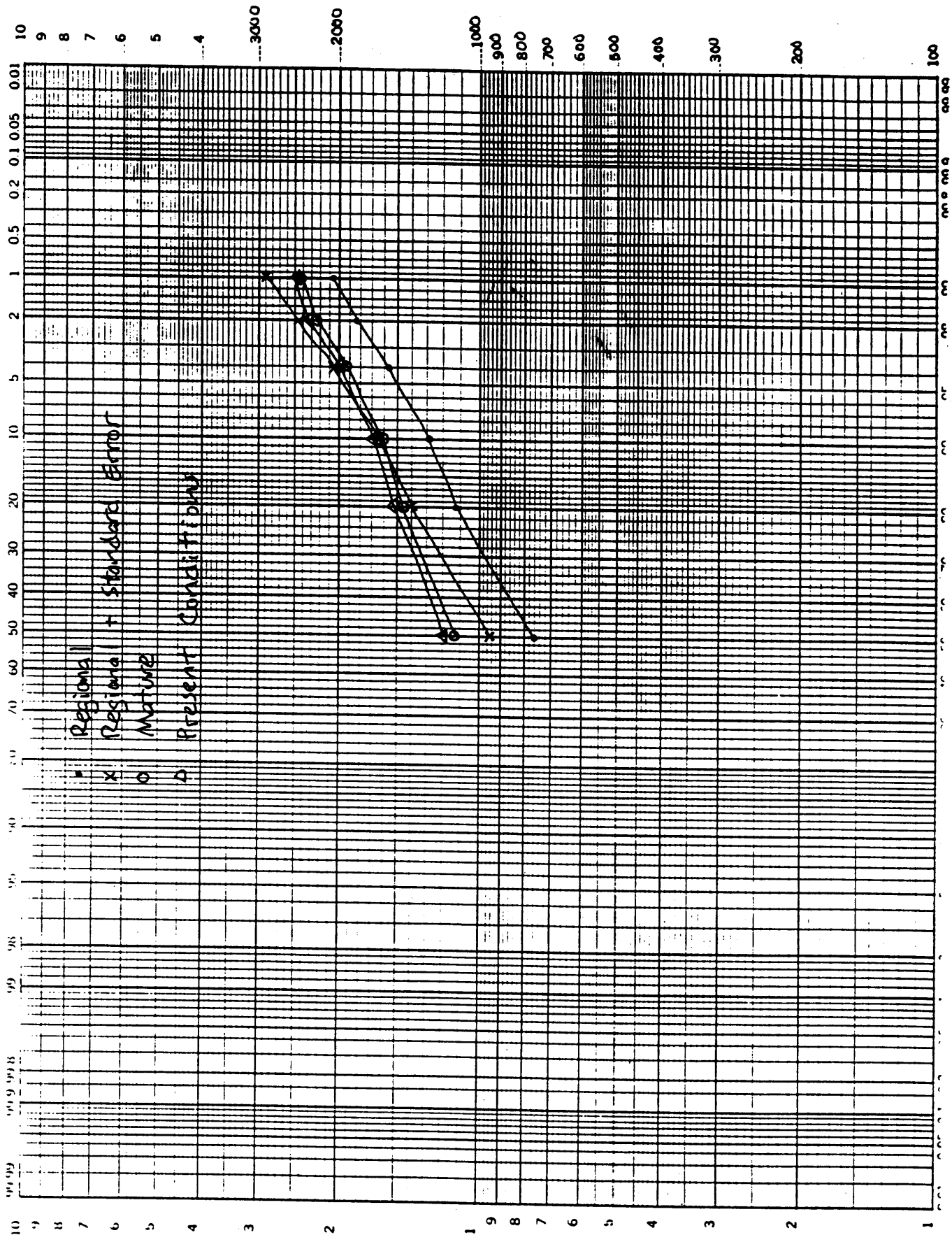
P100 + UNUSUAL MELT IN	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN	P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN
10.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.49	2.19	2.58	2.77	3.16	3.55	3.74	2.38
11.18	0.22	0.26	0.27	0.31	0.35	0.37	0.25
11.68	0.75	0.87	0.93	1.05	1.17	1.23	0.89
11.68	0.25	0.29	0.31	0.35	0.39	0.42	0.30
11.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.13	1.24	1.47	1.58	1.81	2.04	2.15	1.34
10.64	0.03	0.03	0.04	0.04	0.05	0.05	0.03
11.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.76	0.93	1.11	1.20	1.38	1.55	1.64	1.00
10.09	0.13	0.15	0.16	0.19	0.21	0.22	0.14
10.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.34	0.00	0.00	0.00	0.00	0.01	0.01	0.00
10.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.41	0.01	0.02	0.02	0.02	0.02	0.02	0.01
9.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.26	5.76	6.78	7.29	8.32	9.34	9.85	6.35
2415.92	1026.43	1342.52	1500.57	1816.66	2132.75	2290.79	1208.48

P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN	P100 + UNUSUAL MELT IN
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
2.77	2.97	3.36	3.75	3.95
0.29	0.31	0.34	0.38	0.40
1.01	1.07	1.19	1.32	1.38
0.34	0.36	0.40	0.44	0.46
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
1.57	1.68	1.91	2.14	2.26
0.04	0.04	0.05	0.05	0.05
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
1.18	1.27	1.45	1.63	1.71
0.17	0.18	0.20	0.23	0.24
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.01	0.01	0.01
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.02	0.02	0.02	0.02	0.03
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
7.38	7.90	8.93	9.96	10.48
1527.63	1687.21	2006.36	2325.52	2485.09

Sub-basin 11

46 8040

10.2 PROBABILITY OF EXCESS FLOODING



SUB-BASINS 8-11

ional Flood Frequency Worksheet for Tolt River
S. basins 8-11
based on Region I

Recurrence Interval	Regress constant	Area (mi2)	Area exponent	Ann Precip (in)	Precip exponent	Forest cover	For Cover exponent
2	0.191	29.92	0.86	94.00	1.51	1.00	1.00
5	0.257	29.92	0.86	94.00	1.53	1.00	1.00
10	0.288	29.92	0.85	94.00	1.54	1.00	1.00
25	0.317	29.92	0.85	94.00	1.56	1.00	1.00
50	0.332	29.92	0.86	94.00	1.58	1.00	1.00
100	0.343	29.92	0.86	94.00	1.60	1.00	1.00

S. basins 8-11

Q est (ft ³ /s)	Standard error (%)	Q + SE
3,386.63	24.90	4,229.90
4,990.34	24.60	6,217.96
5,656.68	26.90	7,178.32
6,818.53	31.50	8,966.36
8,090.80	35.70	10,979.22
9,153.98	40.30	12,843.04

Level 1 Analysis
Sub-basins 8-11

INPUT INFORMATION

Return Period	Peak Flow (cfs)	24-hour Rainfall (in)	Regress. Peak Flow (cfs)
2	3387.00	5.00	3487.18
5	4990.00	6.00	4861.09
10	5657.00	6.50	5548.05
25	6818.00	7.50	6921.96
50	8091.00	8.50	8295.88
100	9154.00	9.00	8982.84

Regression intercept = -3382.40
Regression slope = 1373.91

Elevation of Zones

=====

Elevation of Lowland =	500 (ft)
Elevation of Rain Dominated =	1100 (ft)
Elevation of Rain on Snow =	2250 (ft)
Elevation of Snow Dominated =	3400 (ft)
Elevation of Highland =	4500 (ft)

Snow Water Equivalent vs Elevation Relationship

=====

Constant =	-3.970 (cm)
Slope =	0.042 (cm/m)
Standard Error =	11.278 (cm)

Air Temperature vs Elevation Relationship

=====

Constant =	8.100 (C)
Slope =	-0.006 (C/m)
Standard Error =	2.000 (C)

Wind Speed

=====

Average Wind Speed =	4 (m/s)
Unusual Wind Speed =	7 (m/s)

Level 1 Analysis

SUMMARY INFORMATION

Basin Score = 4.2626384

Worst Basin Score = 8.5947357

Best Basin Score = 2.1486839

Area in Lowland	0	0.00
Area in Rain Dominated	5876	0.31
Area in Rain on Snow	5151	0.27
Area in Snow Dominated	5817	0.30
Area in Highland	2304	0.12
=====		
TOTAL =	19148	1

Area in Large Dense	412	0.02
Area in Small Dense	9098	0.48
Area in Sparse	4512	0.24
Area in Open	1935	0.10
Area in Non-Forest	2127	0.11
Area in Water	1064	0.06
=====		
TOTAL =	19148	1

1 1 Analysis

Precip Zone- Veg Class	Area (acres)	Precip- Veg Score	Score X Area	P2	P5	P10	P25
L-LD	0.00	1.00	0.00	5.00	6.00	6.50	7.50
L-SD	0.00	1.00	0.00	5.00	6.00	6.50	7.50
L-S	0.00	3.00	0.00	5.00	6.00	6.50	7.50
L-O	0.00	4.00	0.00	5.00	6.00	6.50	7.50
L-NF	0.00	4.00	0.00	5.00	6.00	6.50	7.50
L-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
R-LD	50.00	2.00	100.00	5.00	6.00	6.50	7.50
R-SD	3364.00	2.00	6728.00	5.00	6.00	6.50	7.50
R-S	248.00	6.00	1488.00	5.00	6.00	6.50	7.50
R-O	876.00	8.00	7008.00	5.00	6.00	6.50	7.50
R-NF	291.00	8.00	2328.00	5.00	6.00	6.50	7.50
R-W	1047.00	0.00	0.00	5.00	6.00	6.50	7.50
RS-LD	25.00	3.00	75.00	5.00	6.00	6.50	7.50
RS-SD	3075.00	3.00	9225.00	5.00	6.00	6.50	7.50
RS-S	1759.00	9.00	15831.00	5.00	6.00	6.50	7.50
RS-O	68.00	12.00	816.00	5.00	6.00	6.50	7.50
RS-F	224.00	12.00	2688.00	5.00	6.00	6.50	7.50
RS-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
S-LD	174.00	2.00	348.00	5.00	6.00	6.50	7.50
S-SD	2078.00	2.00	4156.00	5.00	6.00	6.50	7.50
S-S	2033.00	6.00	12198.00	5.00	6.00	6.50	7.50
S-O	816.00	8.00	6528.00	5.00	6.00	6.50	7.50
S-NF	699.00	8.00	5592.00	5.00	6.00	6.50	7.50
S-W	17.00	0.00	0.00	5.00	6.00	6.50	7.50
H-LD	163.00	1.00	163.00	5.00	6.00	6.50	7.50
H-SD	581.00	1.00	581.00	5.00	6.00	6.50	7.50
H-S	472.00	3.00	1416.00	5.00	6.00	6.50	7.50
H-O	175.00	4.00	700.00	5.00	6.00	6.50	7.50
H-NF	913.00	4.00	3652.00	5.00	6.00	6.50	7.50
H-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
TOTAL =							
	19148.00		81621.00				

[illegible]

SWE MODIFIED CM	AIR TEMP C	SE TEMP C	MODIFIED TEMP C	AVERAGE WIND SPEED M/S	UNUSUAL WIND SPEED M/S	FOREST COVER DECIMAL	MODIFIED AVERAGE WIND M/S
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
27.33	7.19	2.00	9.19	4.00	7.00	0.40	2.72
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
0.00	7.19	2.00	9.19	4.00	7.00	0.00	4.00
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
37.26	6.09	2.00	8.09	4.00	7.00	0.40	2.72
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
0.00	6.09	2.00	8.09	4.00	7.00	0.00	4.00
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
53.87	3.99	2.00	5.99	4.00	7.00	0.40	2.72
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
0.00	3.99	2.00	5.99	4.00	7.00	0.00	4.00
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
63.17	1.88	2.00	3.88	4.00	7.00	0.40	2.72
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.00	4.00
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.40	2.72
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.00	4.00

MODIFIED UNUSUAL WIND M/S	AVERAGE MELT P2 CM	AVERAGE MELT P5 CM	AVERAGE MELT P10 CM	AVERAGE MELT P25 CM	AVERAGE MELT P50 CM	AVERAGE MELT P100 CM	UNUSUAL MELT P2 CM
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
4.76	3.32	3.41	3.46	3.55	3.64	3.68	5.79
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
7.00	4.11	4.20	4.25	4.34	4.43	4.47	7.56
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
4.76	2.85	2.92	2.96	3.04	3.12	3.15	5.13
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
7.00	3.52	3.59	3.63	3.71	3.79	3.82	6.68
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
4.76	1.94	1.99	2.02	2.07	2.12	2.14	3.85
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
7.00	2.38	2.43	2.46	2.51	2.56	2.58	5.01
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
4.76	1.04	1.06	1.07	1.10	1.12	1.13	2.58
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
7.00	1.25	1.27	1.28	1.31	1.33	1.34	3.33
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
4.76	0.17	0.17	0.17	0.17	0.17	0.17	1.36
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
7.00	0.16	0.16	0.16	0.16	0.15	0.15	1.72

UNUSUAL MELT P5 CM	UNUSUAL MELT P10 CM	UNUSUAL MELT P25 CM	UNUSUAL MELT P50 CM	UNUSUAL MELT P100 CM	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
5.91	5.96	6.08	6.20	6.25	6.31	7.34	7.86
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.68	7.73	7.85	7.97	8.02	6.62	7.65	8.17
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
5.23	5.28	5.38	5.48	5.53	6.12	7.15	7.67
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.79	6.84	6.94	7.04	7.09	6.38	7.42	7.93
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
3.93	3.97	4.04	4.12	4.15	5.77	6.78	7.29
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
5.08	5.12	5.19	5.27	5.31	5.94	6.96	7.47
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
2.63	2.65	2.70	2.75	2.78	5.41	6.42	6.92
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.38	3.40	3.45	3.50	3.52	5.49	6.50	7.00
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
1.39	1.40	1.42	1.45	1.46	5.07	6.07	6.57
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.75	1.76	1.78	1.81	1.82	5.06	6.06	6.56

Average Input = 5.51 6.53 7.04

Peak Flow = 4190.52 5588.27 6287.14

P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN	P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.90	9.93	10.45	7.28	8.33	8.85	9.89	10.94
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.21	10.24	10.76	7.98	9.02	9.54	10.59	11.64
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.70	9.73	10.24	7.02	8.06	8.58	9.62	10.66
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.96	9.99	10.51	7.63	8.67	9.19	10.23	11.27
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.31	9.33	9.84	6.52	7.55	8.06	9.09	10.12
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.49	9.51	10.02	6.97	8.00	8.52	9.55	10.57
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.93	8.94	9.45	6.02	7.04	7.54	8.56	9.58
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.01	9.02	9.53	6.31	7.33	7.84	8.86	9.88
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.54	6.55	7.05	8.06	9.07
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.68	6.69	7.19	8.20	9.21
8.06	9.07	9.58	5.93	6.96	7.47	8.50	9.53
7684.89	9082.64	9781.51	4767.12	6178.50	6884.19	8295.57	9706.94

*****					AREA WEIGHTED		*****
P100 + UNUSUAL MELT IN	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN	P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN
10.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.49	0.02	0.02	0.02	0.02	0.02	0.03	0.02
10.49	1.02	1.20	1.29	1.48	1.66	1.75	1.11
11.18	0.08	0.09	0.10	0.11	0.13	0.13	0.09
11.68	0.29	0.34	0.36	0.41	0.45	0.48	0.34
11.68	0.10	0.11	0.12	0.14	0.15	0.16	0.11
11.79	0.35	0.41	0.43	0.49	0.55	0.57	0.42
10.13	0.01	0.01	0.01	0.01	0.01	0.01	0.01
10.13	0.89	1.06	1.14	1.30	1.47	1.55	0.96
10.64	0.53	0.62	0.67	0.76	0.86	0.90	0.60
11.01	0.02	0.02	0.03	0.03	0.03	0.04	0.02
11.01	0.07	0.08	0.09	0.10	0.11	0.12	0.08
11.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.76	0.05	0.06	0.06	0.07	0.08	0.09	0.05
9.76	0.58	0.69	0.74	0.85	0.96	1.02	0.62
10.09	0.57	0.68	0.74	0.84	0.95	1.00	0.64
10.34	0.23	0.28	0.30	0.34	0.38	0.41	0.27
10.34	0.20	0.24	0.26	0.29	0.33	0.35	0.23
10.39	0.00	0.01	0.01	0.01	0.01	0.01	0.01
9.41	0.04	0.05	0.06	0.06	0.07	0.08	0.05
9.41	0.15	0.18	0.20	0.23	0.26	0.28	0.16
9.57	0.12	0.15	0.16	0.19	0.21	0.22	0.14
9.69	0.05	0.06	0.06	0.07	0.08	0.08	0.05
9.69	0.24	0.29	0.31	0.36	0.41	0.43	0.27
9.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.04	5.62	6.64	7.15	8.17	9.18	9.69	6.25
10412.63	4342.42	5740.17	6439.04	7836.79	9234.53	9933.41	5199.01

P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN	P100 + UNUSUAL MELT IN
-------------------------------	--------------------------------	--------------------------------	--------------------------------	---------------------------------

0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.02	0.02	0.02	0.03	0.03
1.29	1.39	1.57	1.75	1.84
0.10	0.11	0.12	0.14	0.14
0.39	0.42	0.46	0.51	0.53
0.13	0.14	0.15	0.17	0.18
0.47	0.50	0.56	0.62	0.64
0.01	0.01	0.01	0.01	0.01
1.13	1.21	1.38	1.54	1.63
0.69	0.74	0.84	0.93	0.98
0.03	0.03	0.03	0.04	0.04
0.09	0.10	0.11	0.12	0.13
0.00	0.00	0.00	0.00	0.00
0.06	0.07	0.07	0.08	0.09
0.73	0.78	0.89	1.00	1.06
0.75	0.80	0.91	1.02	1.07
0.31	0.33	0.38	0.42	0.44
0.27	0.28	0.32	0.36	0.38
0.01	0.01	0.01	0.01	0.01
0.05	0.06	0.07	0.08	0.08
0.19	0.21	0.24	0.27	0.29
0.16	0.17	0.20	0.22	0.24
0.06	0.07	0.07	0.08	0.09
0.32	0.34	0.39	0.44	0.46
0.00	0.00	0.00	0.00	0.00

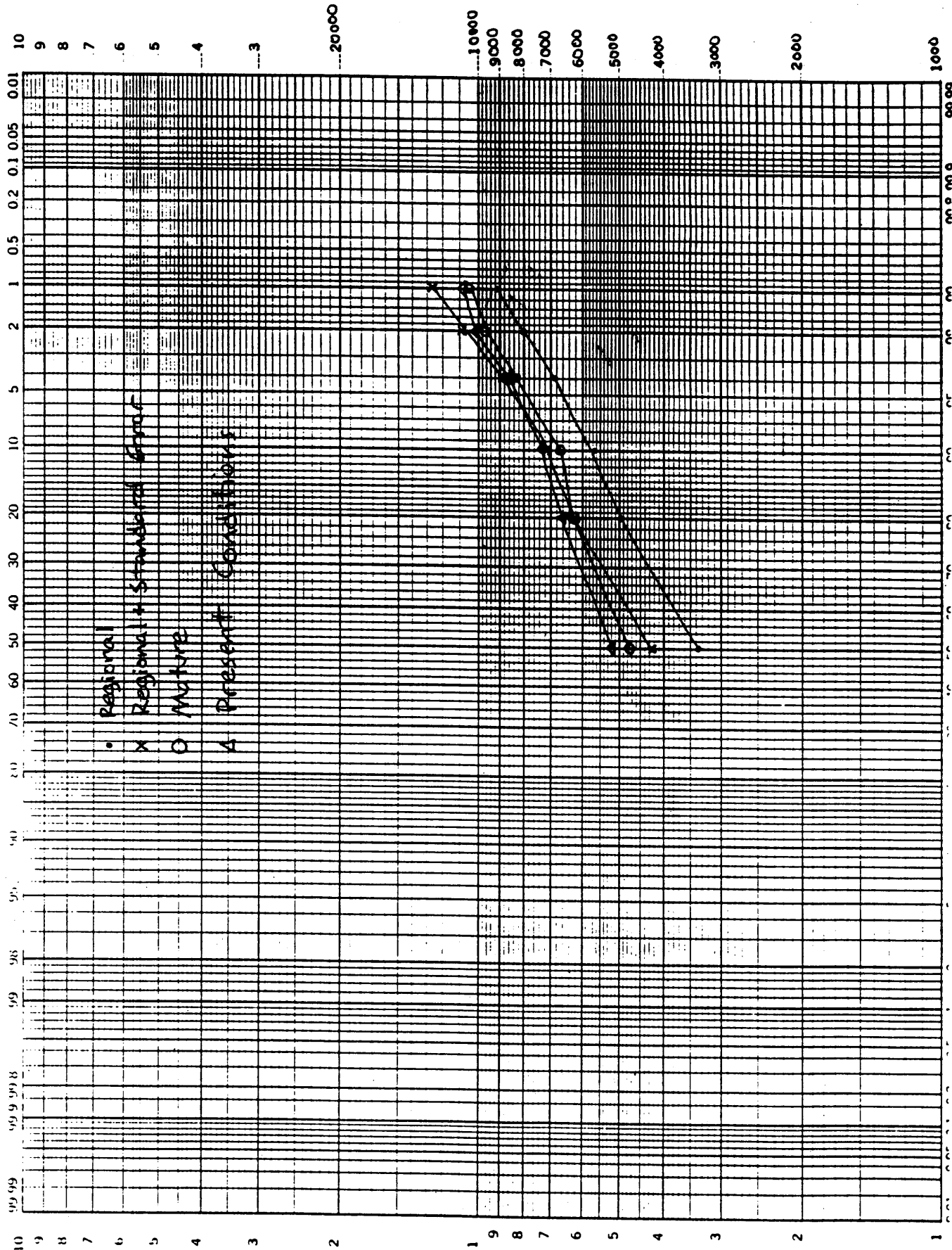
7.27	7.79	8.81	9.84	10.36
------	------	------	------	-------

6610.38	7316.07	8727.45	10138.83	10844.52
---------	---------	---------	----------	----------

Sub-basins 8-11

46 8040

100% PROBABILITIES OF EXCEEDANCE



SUB-BASINS 8-12

Regional Flood Frequency Worksheet for Tolt River
 Subbasins 8-12
 based on Region I

Recurrence Interval	Regress constant	Area (mi ²)	Area exponent	Ann Precip (in)	Precip exponent	Forest cover	For Cover exponent
2	0.191	32.12	0.86	94.00	1.51	1.00	1.00
5	0.257	32.12	0.86	94.00	1.53	1.00	1.00
10	0.288	32.12	0.85	94.00	1.54	1.00	1.00
25	0.317	32.12	0.85	94.00	1.56	1.00	1.00
50	0.332	32.12	0.86	94.00	1.58	1.00	1.00
100	0.343	32.12	0.86	94.00	1.60	1.00	1.00

Sum basins 8-12

Q est (ft ³ /s)	Standard error (%)	Q + SE
3,599.72	24.90	4,496.05
5,304.34	24.60	6,609.20
6,008.34	26.90	7,624.58
7,242.42	31.50	9,523.78
8,599.88	35.70	11,670.04
9,729.96	40.30	13,651.14

Level 1 Analysis
Sub-basins 8-12

INPUT INFORMATION

Return Period	Peak Flow (cfs)	24-hour Rainfall (in)	Regress. Peak Flow (cfs)
2	3600.00	5.00	3704.75
5	5304.00	6.00	5165.19
10	6008.00	6.50	5895.41
25	7242.00	7.50	7355.85
50	8600.00	8.50	8816.29
100	9730.00	9.00	9546.51

Regression intercept = -3597.46
Regression slope = 1460.44

Elevation of Zones

Elevation of Lowland = 500 (ft)
Elevation of Rain Dominated = 1100 (ft)
Elevation of Rain on Snow = 2250 (ft)
Elevation of Snow Dominated = 3400 (ft)
Elevation of Highland = 4500 (ft)

Snow Water Equivalent vs Elevation Relationship

Constant = -3.970 (cm)
Slope = 0.042 (cm/m)
Standard Error = 11.278 (cm)

Air Temperature vs Elevation Relationship

Constant = 8.100 (C)
Slope = -0.006 (C/m)
Standard Error = 2.000 (C)

Wind Speed

Average Wind Speed = 4 (m/s)
Unusual Wind Speed = 7 (m/s)

Level 1 Analysis

SUMMARY INFORMATION

Basin Score = 4.2505837

Worst Basin Score = 8.5539988

Best Basin Score = 2.1384997

Area in Lowland	0	0.00
Area in Rain Dominated	7284	0.35
Area in Rain on Snow	5151	0.25
Area in Snow Dominated	5817	0.28
Area in Highland	2304	0.11
=====		
TOTAL =	20556	1

Area in Large Dense	490	0.02
Area in Small Dense	9893	0.48
Area in Sparse	4648	0.23
Area in Open	2283	0.11
Area in Non-Forest	2178	0.11
Area in Water	1064	0.05
=====		
TOTAL =	20556	1

Level 1 Analysis

Precip Zone- Veg Class	Area (acres)	Precip- Veg Score	Score X Area	P2	P5	P10	P25
L-LD	0.00	1.00	0.00	5.00	6.00	6.50	7.50
L-SD	0.00	1.00	0.00	5.00	6.00	6.50	7.50
L-S	0.00	3.00	0.00	5.00	6.00	6.50	7.50
L-O	0.00	4.00	0.00	5.00	6.00	6.50	7.50
L-NF	0.00	4.00	0.00	5.00	6.00	6.50	7.50
L-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
R-LD	128.00	2.00	256.00	5.00	6.00	6.50	7.50
R-SD	4159.00	2.00	8318.00	5.00	6.00	6.50	7.50
R-S	384.00	6.00	2304.00	5.00	6.00	6.50	7.50
R-O	1224.00	8.00	9792.00	5.00	6.00	6.50	7.50
R-NF	342.00	8.00	2736.00	5.00	6.00	6.50	7.50
R-W	1047.00	0.00	0.00	5.00	6.00	6.50	7.50
RS-LD	25.00	3.00	75.00	5.00	6.00	6.50	7.50
RS-SD	3075.00	3.00	9225.00	5.00	6.00	6.50	7.50
RS-S	1759.00	9.00	15831.00	5.00	6.00	6.50	7.50
RS-O	68.00	12.00	816.00	5.00	6.00	6.50	7.50
RS-NF	224.00	12.00	2688.00	5.00	6.00	6.50	7.50
R-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
S-LD	174.00	2.00	348.00	5.00	6.00	6.50	7.50
S-SD	2078.00	2.00	4156.00	5.00	6.00	6.50	7.50
S-S	2033.00	6.00	12198.00	5.00	6.00	6.50	7.50
S-O	816.00	8.00	6528.00	5.00	6.00	6.50	7.50
S-NF	699.00	8.00	5592.00	5.00	6.00	6.50	7.50
S-W	17.00	0.00	0.00	5.00	6.00	6.50	7.50
H-LD	163.00	1.00	163.00	5.00	6.00	6.50	7.50
H-SD	581.00	1.00	581.00	5.00	6.00	6.50	7.50
H-S	472.00	3.00	1416.00	5.00	6.00	6.50	7.50
H-O	175.00	4.00	700.00	5.00	6.00	6.50	7.50
H-NF	913.00	4.00	3652.00	5.00	6.00	6.50	7.50
H-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
TOTAL =							
				20556.00	87375.00		

[illegible]

SWE MODIFIED CM	AIR TEMP C	SE TEMP C	MODIFIED TEMP C	AVERAGE WIND SPEED M/S	UNUSUAL WIND SPEED M/S	FOREST COVER DECIMAL	MODIFIED AVERAGE WIND M/S
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
27.33	7.19	2.00	9.19	4.00	7.00	0.40	2.72
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
0.00	7.19	2.00	9.19	4.00	7.00	0.00	4.00
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
37.26	6.09	2.00	8.09	4.00	7.00	0.40	2.72
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
0.00	6.09	2.00	8.09	4.00	7.00	0.00	4.00
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
53.87	3.99	2.00	5.99	4.00	7.00	0.40	2.72
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
0.00	3.99	2.00	5.99	4.00	7.00	0.00	4.00
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
63.17	1.88	2.00	3.88	4.00	7.00	0.40	2.72
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.00	4.00
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.40	2.72
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.00	4.00

MODIFIED UNUSUAL WIND M/S	AVERAGE MELT P2 CM	AVERAGE MELT P5 CM	AVERAGE MELT P10 CM	AVERAGE MELT P25 CM	AVERAGE MELT P50 CM	AVERAGE MELT P100 CM	UNUSUAL MELT P2 CM
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
4.76	3.32	3.41	3.46	3.55	3.64	3.68	5.79
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
7.00	4.11	4.20	4.25	4.34	4.43	4.47	7.56
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
4.76	2.85	2.92	2.96	3.04	3.12	3.15	5.13
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
7.00	3.52	3.59	3.63	3.71	3.79	3.82	6.68
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
4.76	1.94	1.99	2.02	2.07	2.12	2.14	3.85
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
7.00	2.38	2.43	2.46	2.51	2.56	2.58	5.01
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
4.76	1.04	1.06	1.07	1.10	1.12	1.13	2.58
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
7.00	1.25	1.27	1.28	1.31	1.33	1.34	3.33
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
4.76	0.17	0.17	0.17	0.17	0.17	0.17	1.36
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
7.00	0.16	0.16	0.16	0.16	0.15	0.15	1.72

UNUSUAL MELT P5 CM	UNUSUAL MELT P10 CM	UNUSUAL MELT P25 CM	UNUSUAL MELT P50 CM	UNUSUAL MELT P100 CM	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
5.91	5.96	6.08	6.20	6.25	6.31	7.34	7.86
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.68	7.73	7.85	7.97	8.02	6.62	7.65	8.17
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
5.23	5.28	5.38	5.48	5.53	6.12	7.15	7.67
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.79	6.84	6.94	7.04	7.09	6.38	7.42	7.93
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
3.93	3.97	4.04	4.12	4.15	5.77	6.78	7.29
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
5.08	5.12	5.19	5.27	5.31	5.94	6.96	7.47
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
2.63	2.65	2.70	2.75	2.78	5.41	6.42	6.92
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.38	3.40	3.45	3.50	3.52	5.49	6.50	7.00
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
1.39	1.40	1.42	1.45	1.46	5.07	6.07	6.57
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.75	1.76	1.78	1.81	1.82	5.06	6.06	6.56

Average Input = 5.53 6.55 7.06

Peak Flow = 4483.63 5970.69 6714.22

P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN	P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.90	9.93	10.45	7.28	8.33	8.85	9.89	10.94
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.21	10.24	10.76	7.98	9.02	9.54	10.59	11.64
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.70	9.73	10.24	7.02	8.06	8.58	9.62	10.66
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.96	9.99	10.51	7.63	8.67	9.19	10.23	11.27
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.31	9.33	9.84	6.52	7.55	8.06	9.09	10.12
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.49	9.51	10.02	6.97	8.00	8.52	9.55	10.57
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.93	8.94	9.45	6.02	7.04	7.54	8.56	9.58
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.01	9.02	9.53	6.31	7.33	7.84	8.86	9.88
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.54	6.55	7.05	8.06	9.07
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.68	6.69	7.19	8.20	9.21
8.08	9.10	9.61	5.96	6.99	7.50	8.53	9.56
8201.28	9688.34	10431.87	5104.97	6606.52	7357.29	8858.84	10360.39

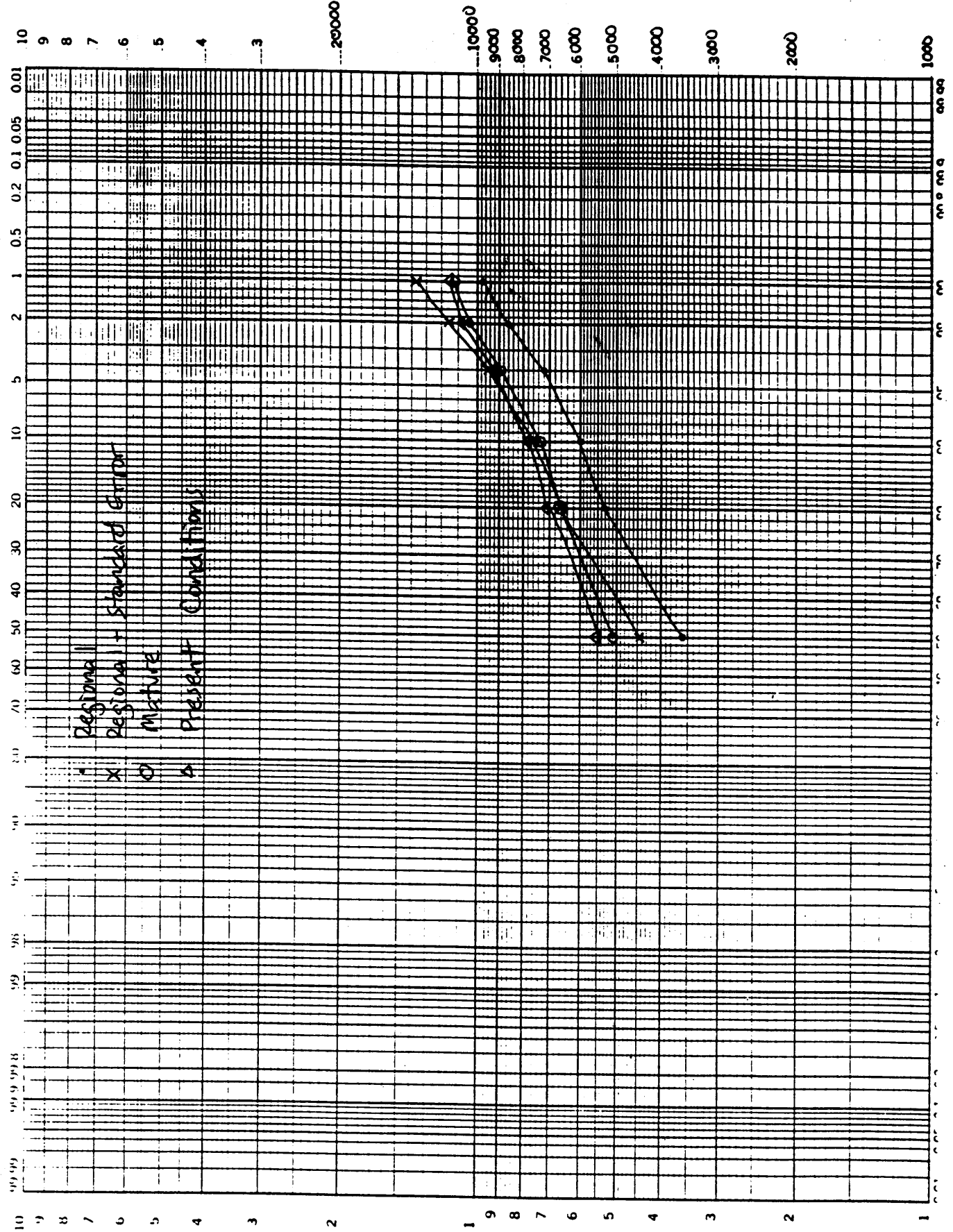
*****					AREA WEIGHTED		*****
P100 + UNUSUAL MELT IN	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN	P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN
10.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.49	0.04	0.04	0.05	0.05	0.06	0.06	0.04
10.49	1.18	1.39	1.49	1.70	1.91	2.01	1.28
11.18	0.11	0.13	0.14	0.16	0.18	0.19	0.13
11.68	0.38	0.44	0.47	0.53	0.59	0.62	0.45
11.68	0.11	0.12	0.13	0.15	0.17	0.17	0.13
11.79	0.33	0.38	0.40	0.46	0.51	0.54	0.39
10.13	0.01	0.01	0.01	0.01	0.01	0.01	0.01
10.13	0.83	0.99	1.06	1.21	1.37	1.44	0.90
10.64	0.49	0.58	0.62	0.71	0.80	0.84	0.56
11.01	0.02	0.02	0.02	0.03	0.03	0.03	0.02
11.01	0.06	0.08	0.08	0.09	0.10	0.11	0.08
11.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.76	0.05	0.05	0.06	0.07	0.07	0.08	0.05
9.76	0.54	0.64	0.69	0.79	0.89	0.95	0.57
10.09	0.53	0.63	0.68	0.78	0.88	0.93	0.59
10.34	0.22	0.26	0.28	0.32	0.36	0.38	0.25
10.34	0.19	0.22	0.24	0.27	0.31	0.32	0.21
10.39	0.00	0.01	0.01	0.01	0.01	0.01	0.01
9.41	0.04	0.05	0.05	0.06	0.07	0.07	0.04
9.41	0.14	0.17	0.19	0.21	0.24	0.26	0.15
9.57	0.12	0.14	0.15	0.17	0.20	0.21	0.13
9.69	0.04	0.05	0.06	0.06	0.07	0.08	0.05
9.69	0.22	0.27	0.29	0.34	0.38	0.40	0.25
9.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.07	5.65	6.67	7.18	8.19	9.21	9.72	6.28
11111.17	4651.49	6138.55	6882.08	8369.14	9856.20	10599.73	5573.18

P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN	P100 + UNUSUAL MELT IN
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.05	0.05	0.06	0.06	0.07
1.49	1.60	1.81	2.02	2.12
0.15	0.16	0.18	0.20	0.21
0.51	0.54	0.60	0.66	0.70
0.14	0.15	0.17	0.19	0.19
0.44	0.47	0.52	0.57	0.60
0.01	0.01	0.01	0.01	0.01
1.05	1.13	1.28	1.44	1.51
0.65	0.69	0.78	0.87	0.91
0.03	0.03	0.03	0.03	0.04
0.09	0.09	0.10	0.11	0.12
0.00	0.00	0.00	0.00	0.00
0.06	0.06	0.07	0.08	0.08
0.68	0.73	0.83	0.94	0.99
0.70	0.75	0.85	0.95	1.00
0.29	0.31	0.35	0.39	0.41
0.25	0.26	0.30	0.33	0.35
0.01	0.01	0.01	0.01	0.01
0.05	0.05	0.06	0.07	0.07
0.18	0.19	0.22	0.25	0.27
0.15	0.16	0.19	0.21	0.22
0.06	0.06	0.07	0.08	0.08
0.30	0.32	0.36	0.41	0.43
0.00	0.00	0.00	0.00	0.00
7.31	7.82	8.85	9.88	10.39
7074.73	7825.51	9327.06	10828.61	11579.38

Sub-basins 8-12

46 8040

Fig. 1. Probability of Flood Exceedence
at a Given Station



SUB-BASINS 1-13

Annual Flood Frequency Worksheet for Tolt River
basins 1-13
based on Region I

Recurrence Interval	Regress constant	Area (mi ²)	Area exponent	Ann Precip (in)	Precip exponent	Forest cover	For Cover exponent
2	0.191	87.71	0.86	94.00	1.51	1.00	1.00
5	0.257	87.71	0.86	94.00	1.53	1.00	1.00
10	0.288	87.71	0.85	94.00	1.54	1.00	1.00
25	0.317	87.71	0.85	94.00	1.56	1.00	1.00
50	0.332	87.71	0.86	94.00	1.58	1.00	1.00
100	0.343	87.71	0.86	94.00	1.60	1.00	1.00

basins 1-13

Q est ft ³ /s)	Standard error (%)	Q + SE
8,540.36	24.90	10,666.91
12,584.57	24.60	15,680.37
14,112.32	26.90	17,908.54
17,010.92	31.50	22,369.36
20,403.26	35.70	27,687.23
23,084.38	40.30	32,387.39

Level 1 Analysis
Sub-basins 1-13

INPUT INFORMATION

Return Period	Peak Flow (cfs)	24-hour Rainfall (in)	Regress. Peak Flow (cfs)
2	8540.00	5.00	8735.00
5	12584.00	6.00	12200.92
10	14112.00	6.50	13933.88
25	17011.00	7.50	17399.80
50	20403.00	8.50	20865.72
100	23084.00	9.00	22598.68

Regression intercept = -8594.61
Regression slope = 3465.92

Elevation of Zones

Elevation of Lowland = 500 (ft)
Elevation of Rain Dominated = 1100 (ft)
Elevation of Rain on Snow = 2250 (ft)
Elevation of Snow Dominated = 3400 (ft)
Elevation of Highland = 4500 (ft)

Snow Water Equivalent vs Elevation Relationship

Constant = -3.970 (cm)
Slope = 0.042 (cm/m)
Standard Error = 11.278 (cm)

Air Temperature vs Elevation Relationship

Constant = 8.100 (C)
Slope = -0.006 (C/m)
Standard Error = 2.000 (C)

Wind Speed

Average Wind Speed = 4 (m/s)
Unusual Wind Speed = 7 (m/s)

Level 1 Analysis

SUMMARY INFORMATION

Basin Score = 4.4111055

Worst Basin Score = 8.7115117

Best Basin Score = 2.1778779

Area in Lowland	458	0.01
Area in Rain Dominated	21066	0.38
Area in Rain on Snow	15668	0.28
Area in Snow Dominated	13717	0.24
Area in Highland	5225	0.09
=====		
TOTAL =	56134	1

Area in Large Dense	1994	0.04
Area in Small Dense	28025	0.50
Area in Sparse	12907	0.23
Area in Open	7023	0.13
Area in Non-Forest	5036	0.09
Area in Water	1149	0.02
=====		
TOTAL =	56134	1

l 1 Analysis

Precip Zone- Veg Class	Area (acres)	Precip- Veg Score	Score X Area	P2	P5	P10	P25
L-LD	0.00	1.00	0.00	5.00	6.00	6.50	7.50
L-SD	102.00	1.00	102.00	5.00	6.00	6.50	7.50
L-S	88.00	3.00	264.00	5.00	6.00	6.50	7.50
L-O	197.00	4.00	788.00	5.00	6.00	6.50	7.50
L-NF	63.00	4.00	252.00	5.00	6.00	6.50	7.50
L-W	8.00	0.00	0.00	5.00	6.00	6.50	7.50
R-LD	154.00	2.00	308.00	5.00	6.00	6.50	7.50
R-SD	12996.00	2.00	25992.00	5.00	6.00	6.50	7.50
R-S	2096.00	6.00	12576.00	5.00	6.00	6.50	7.50
R-O	3662.00	8.00	29296.00	5.00	6.00	6.50	7.50
R-NF	1054.00	8.00	8432.00	5.00	6.00	6.50	7.50
R-W	1104.00	0.00	0.00	5.00	6.00	6.50	7.50
RS-LD	273.00	3.00	819.00	5.00	6.00	6.50	7.50
RS-SD	8918.00	3.00	26754.00	5.00	6.00	6.50	7.50
RS-S	5299.00	9.00	47691.00	5.00	6.00	6.50	7.50
RS-O	573.00	12.00	6876.00	5.00	6.00	6.50	7.50
RS-IF	599.00	12.00	7188.00	5.00	6.00	6.50	7.50
RS-W	6.00	0.00	0.00	5.00	6.00	6.50	7.50
S-LD	1057.00	2.00	2114.00	5.00	6.00	6.50	7.50
S-SD	4733.00	2.00	9466.00	5.00	6.00	6.50	7.50
S-S	4591.00	6.00	27546.00	5.00	6.00	6.50	7.50
S-O	1969.00	8.00	15752.00	5.00	6.00	6.50	7.50
S-NF	1336.00	8.00	10688.00	5.00	6.00	6.50	7.50
S-W	31.00	0.00	0.00	5.00	6.00	6.50	7.50
H-LD	510.00	1.00	510.00	5.00	6.00	6.50	7.50
H-SD	1276.00	1.00	1276.00	5.00	6.00	6.50	7.50
H-S	833.00	3.00	2499.00	5.00	6.00	6.50	7.50
H-O	622.00	4.00	2488.00	5.00	6.00	6.50	7.50
H-NF	1984.00	4.00	7936.00	5.00	6.00	6.50	7.50
H-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
=====							
TOTAL =	56134.00		247613.00				

[illegible]

SWE MODIFIED CM	AIR TEMP C	SE TEMP C	MODIFIED TEMP C	AVERAGE WIND SPEED M/S	UNUSUAL WIND SPEED M/S	FOREST COVER DECIMAL	MODIFIED AVERAGE WIND M/S
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
27.33	7.19	2.00	9.19	4.00	7.00	0.40	2.72
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
0.00	7.19	2.00	9.19	4.00	7.00	0.00	4.00
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
37.26	6.09	2.00	8.09	4.00	7.00	0.40	2.72
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
0.00	6.09	2.00	8.09	4.00	7.00	0.00	4.00
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
53.87	3.99	2.00	5.99	4.00	7.00	0.40	2.72
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
0.00	3.99	2.00	5.99	4.00	7.00	0.00	4.00
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
63.17	1.88	2.00	3.88	4.00	7.00	0.40	2.72
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.00	4.00
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.40	2.72
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.00	4.00

MODIFIED UNUSUAL WIND M/S	AVERAGE MELT P2 CM	AVERAGE MELT P5 CM	AVERAGE MELT P10 CM	AVERAGE MELT P25 CM	AVERAGE MELT P50 CM	AVERAGE MELT P100 CM	UNUSUAL MELT P2 CM
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
4.76	3.32	3.41	3.46	3.55	3.64	3.68	5.79
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
7.00	4.11	4.20	4.25	4.34	4.43	4.47	7.56
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
4.76	2.85	2.92	2.96	3.04	3.12	3.15	5.13
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
7.00	3.52	3.59	3.63	3.71	3.79	3.82	6.68
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
4.76	1.94	1.99	2.02	2.07	2.12	2.14	3.85
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
7.00	2.38	2.43	2.46	2.51	2.56	2.58	5.01
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
4.76	1.04	1.06	1.07	1.10	1.12	1.13	2.58
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
7.00	1.25	1.27	1.28	1.31	1.33	1.34	3.33
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
4.76	0.17	0.17	0.17	0.17	0.17	0.17	1.36
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
7.00	0.16	0.16	0.16	0.16	0.15	0.15	1.72

UNUSUAL MELT P5 CM	UNUSUAL MELT P10 CM	UNUSUAL MELT P25 CM	UNUSUAL MELT P50 CM	UNUSUAL MELT P100 CM	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
5.91	5.96	6.08	6.20	6.25	6.31	7.34	7.86
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.68	7.73	7.85	7.97	8.02	6.62	7.65	8.17
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
5.23	5.28	5.38	5.48	5.53	6.12	7.15	7.67
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.79	6.84	6.94	7.04	7.09	6.38	7.42	7.93
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
3.93	3.97	4.04	4.12	4.15	5.77	6.78	7.29
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
5.08	5.12	5.19	5.27	5.31	5.94	6.96	7.47
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
2.63	2.65	2.70	2.75	2.78	5.41	6.42	6.92
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.38	3.40	3.45	3.50	3.52	5.49	6.50	7.00
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
1.39	1.40	1.42	1.45	1.46	5.07	6.07	6.57
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.75	1.76	1.78	1.81	1.82	5.06	6.06	6.56

Average Input = 5.56 6.58 7.09

Peak Flow = 10679.31 14212.35 15978.87

P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN	P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.90	9.93	10.45	7.28	8.33	8.85	9.89	10.94
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.21	10.24	10.76	7.98	9.02	9.54	10.59	11.64
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.70	9.73	10.24	7.02	8.06	8.58	9.62	10.66
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.96	9.99	10.51	7.63	8.67	9.19	10.23	11.27
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.31	9.33	9.84	6.52	7.55	8.06	9.09	10.12
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.49	9.51	10.02	6.97	8.00	8.52	9.55	10.57
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.93	8.94	9.45	6.02	7.04	7.54	8.56	9.58
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.01	9.02	9.53	6.31	7.33	7.84	8.86	9.88
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.54	6.55	7.05	8.06	9.07
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.68	6.69	7.19	8.20	9.21
8.11	9.13	9.64	5.99	7.02	7.54	8.57	9.60
19511.91	23044.95	24811.47	12179.73	15747.16	17530.87	21098.30	24665.72

AREA WEIGHTED

P100 + UNUSUAL MELT IN	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN	P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN
---------------------------------	-------------------------------	-------------------------------	--------------------------------	--------------------------------	--------------------------------	---------------------------------	-------------------------------

10.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.68	0.01	0.01	0.01	0.02	0.02	0.02	0.01
11.46	0.01	0.01	0.01	0.01	0.02	0.02	0.01
12.04	0.02	0.03	0.03	0.03	0.04	0.04	0.03
12.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01
12.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.49	0.02	0.02	0.02	0.02	0.03	0.03	0.02
10.49	1.35	1.59	1.71	1.94	2.18	2.30	1.47
11.18	0.23	0.27	0.29	0.32	0.36	0.38	0.26
11.68	0.41	0.48	0.51	0.58	0.65	0.68	0.49
11.68	0.12	0.14	0.15	0.17	0.19	0.20	0.14
11.79	0.13	0.15	0.16	0.18	0.20	0.21	0.15
10.13	0.03	0.03	0.03	0.04	0.04	0.05	0.03
10.13	0.89	1.05	1.13	1.29	1.45	1.53	0.95
10.64	0.54	0.64	0.69	0.78	0.88	0.93	0.62
11.01	0.06	0.07	0.08	0.09	0.10	0.10	0.07
11.01	0.06	0.07	0.08	0.09	0.10	0.11	0.07
11.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.76	0.10	0.12	0.13	0.15	0.17	0.18	0.11
9.76	0.45	0.53	0.58	0.66	0.75	0.79	0.48
10.09	0.44	0.52	0.57	0.65	0.73	0.77	0.49
10.34	0.19	0.23	0.25	0.28	0.32	0.33	0.22
10.34	0.13	0.15	0.17	0.19	0.21	0.23	0.15
10.39	0.00	0.00	0.00	0.00	0.00	0.01	0.00
9.41	0.05	0.06	0.06	0.07	0.08	0.08	0.05
9.41	0.12	0.14	0.15	0.17	0.19	0.21	0.12
9.57	0.08	0.09	0.10	0.11	0.13	0.13	0.08
9.69	0.06	0.07	0.07	0.08	0.09	0.10	0.06
9.69	0.18	0.21	0.23	0.27	0.30	0.32	0.20
9.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00

10.11	5.67	6.69	7.20	8.22	9.24	9.75	6.30
-------	------	------	------	------	------	------	------

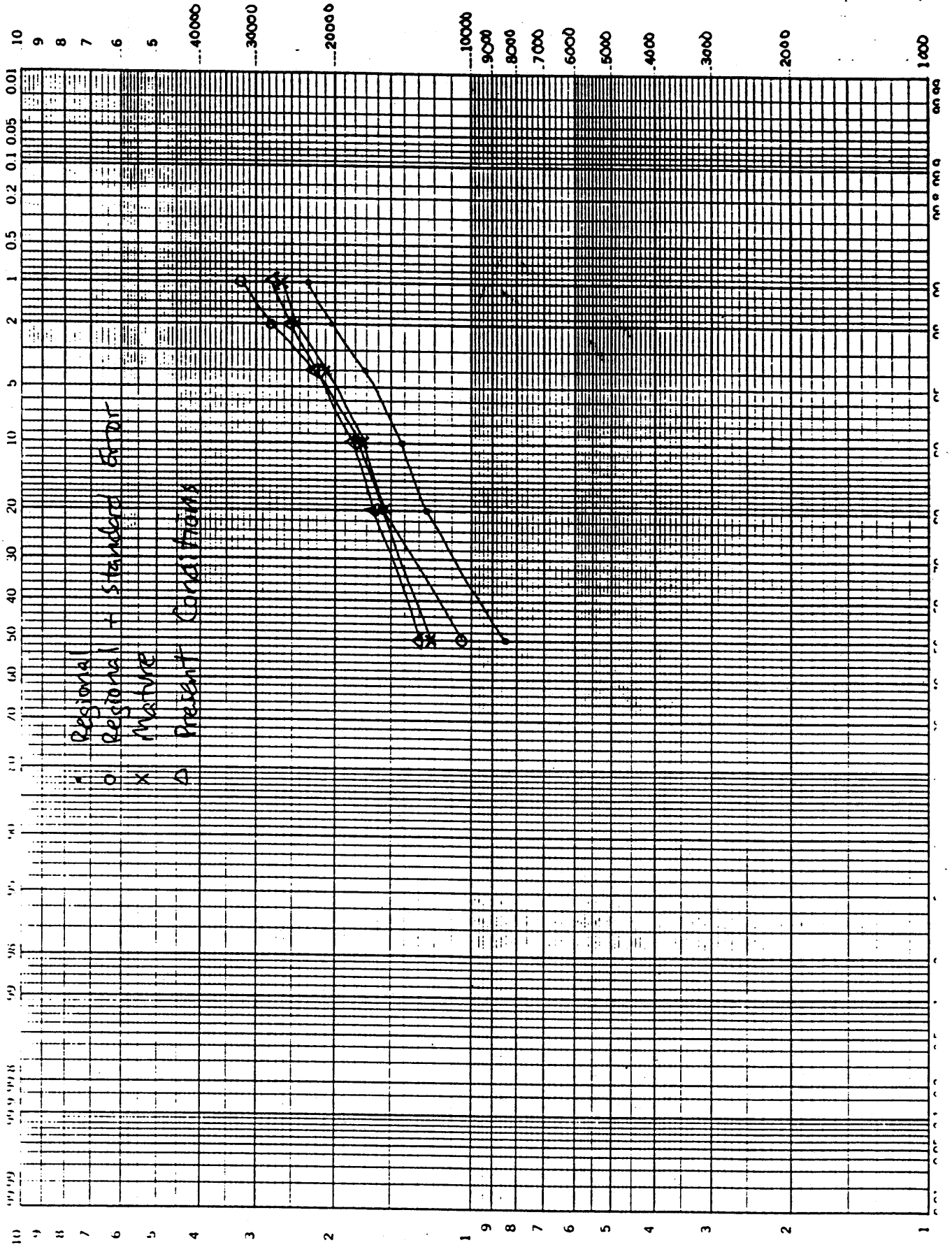
26449.44	11062.56	14595.60	16362.12	19895.16	23428.21	25194.73	13229.51
----------	----------	----------	----------	----------	----------	----------	----------

P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN	P100 + UNUSUAL MELT IN
0.00	0.00	0.00	0.00	0.00
0.01	0.01	0.02	0.02	0.02
0.01	0.01	0.02	0.02	0.02
0.03	0.03	0.04	0.04	0.04
0.01	0.01	0.01	0.01	0.01
0.00	0.00	0.00	0.00	0.00
0.02	0.02	0.02	0.03	0.03
1.71	1.83	2.07	2.31	2.43
0.30	0.32	0.36	0.40	0.42
0.56	0.59	0.66	0.73	0.76
0.16	0.17	0.19	0.21	0.22
0.17	0.18	0.20	0.22	0.23
0.03	0.04	0.04	0.05	0.05
1.12	1.20	1.36	1.53	1.61
0.71	0.76	0.86	0.96	1.00
0.08	0.09	0.10	0.11	0.11
0.08	0.09	0.10	0.11	0.12
0.00	0.00	0.00	0.00	0.00
0.13	0.14	0.16	0.17	0.18
0.57	0.61	0.69	0.78	0.82
0.58	0.62	0.70	0.78	0.83
0.26	0.27	0.31	0.34	0.36
0.17	0.19	0.21	0.23	0.25
0.00	0.00	0.00	0.01	0.01
0.06	0.06	0.07	0.08	0.09
0.15	0.16	0.18	0.20	0.21
0.10	0.10	0.12	0.13	0.14
0.07	0.08	0.09	0.10	0.11
0.24	0.25	0.29	0.32	0.34
0.00	0.00	0.00	0.00	0.00
7.33	7.84	8.87	9.90	10.41
16796.94	18580.65	22148.08	25715.51	27499.22

Sub-basins 1-13

46 8040

PROBABILITY OF EXCESSIVE DAMAGE



SUB-BASINS 1-14

Regional Flood Frequency Worksheet for Tolt River
 Subbasins 1-14
 based on Region I

Recurrence Interval	Regress constant	Area (mi ²)	Area exponent	Ann Precip (in)	Precip exponent	Forest cover	For Cover exponent
2	0.191	99.01	0.86	94.00	1.51	1.00	1.00
5	0.257	99.01	0.86	94.00	1.53	1.00	1.00
10	0.288	99.01	0.85	94.00	1.54	1.00	1.00
25	0.317	99.01	0.85	94.00	1.56	1.00	1.00
50	0.332	99.01	0.86	94.00	1.58	1.00	1.00
100	0.343	99.01	0.86	94.00	1.60	1.00	1.00

SL Basins 1-14

Q est (ft ³ /s)	Standard error (%)	Q + SE
9,478.85	24.90	11,839.09
13,967.48	24.60	17,403.48
15,644.14	26.90	19,852.42
18,857.37	31.50	24,797.44
22,645.37	35.70	30,729.77
25,621.11	40.30	35,946.42

Level 1 Analysis
Sub-basins 1-14

INPUT INFORMATION

Return Period	Peak Flow (cfs)	24-hour Rainfall (in)	Regress. Peak Flow (cfs)
2	9479.00	5.00	9687.95
5	13967.00	6.00	13534.77
10	15644.00	6.50	15458.19
25	18857.00	7.50	19305.01
50	22645.00	8.50	23151.84
100	25621.00	9.00	25075.25

Regression intercept = -9546.18
Regression slope = 3846.83

Elevation of Zones

Elevation of Lowland = 500 (ft)
Elevation of Rain Dominated = 1100 (ft)
Elevation of Rain on Snow = 2250 (ft)
Elevation of Snow Dominated = 3400 (ft)
Elevation of Highland = 4500 (ft)

Snow Water Equivalent vs Elevation Relationship

Constant = -3.970 (cm)
Slope = 0.042 (cm/m)
Standard Error = 11.278 (cm)

Air Temperature vs Elevation Relationship

Constant = 8.100 (C)
Slope = -0.006 (C/m)
Standard Error = 2.000 (C)

Wind Speed

Average Wind Speed = 4 (m/s)
Unusual Wind Speed = 7 (m/s)

Level 1 Analysis

SUMMARY INFORMATION

Basin Score = 4.2207861

Worst Basin Score = 8.2665025

Best Basin Score = 2.0666256

Area in Lowland	6221	0.10
Area in Rain Dominated	22538	0.36
Area in Rain on Snow	15668	0.25
Area in Snow Dominated	13717	0.22
Area in Highland	5225	0.08
=====		
TOTAL =	63369	1

Area in Large Dense	2053	0.03
Area in Small Dense	31080	0.49
Area in Sparse	14752	0.23
Area in Open	8652	0.14
Area in Non-Forest	5565	0.09
Area in Water	1267	0.02
=====		
TOTAL =	63369	1

1 Analysis

Precip Zone- Veg Class	Area (acres)	Precip- Veg Score	Score X Area	P2	P5	P10	P25
-LD	58.00	1.00	58.00	5.00	6.00	6.50	7.50
-SD	2134.00	1.00	2134.00	5.00	6.00	6.50	7.50
-S	1690.00	3.00	5070.00	5.00	6.00	6.50	7.50
-O	1682.00	4.00	6728.00	5.00	6.00	6.50	7.50
-NF	531.00	4.00	2124.00	5.00	6.00	6.50	7.50
-W	126.00	0.00	0.00	5.00	6.00	6.50	7.50
-LD	155.00	2.00	310.00	5.00	6.00	6.50	7.50
-SD	14019.00	2.00	28038.00	5.00	6.00	6.50	7.50
-S	2339.00	6.00	14034.00	5.00	6.00	6.50	7.50
-O	3806.00	8.00	30448.00	5.00	6.00	6.50	7.50
-NF	1115.00	8.00	8920.00	5.00	6.00	6.50	7.50
-W	1104.00	0.00	0.00	5.00	6.00	6.50	7.50
S-LD	273.00	3.00	819.00	5.00	6.00	6.50	7.50
S-SD	8918.00	3.00	26754.00	5.00	6.00	6.50	7.50
S-S	5299.00	9.00	47691.00	5.00	6.00	6.50	7.50
O	573.00	12.00	6876.00	5.00	6.00	6.50	7.50
S	599.00	12.00	7188.00	5.00	6.00	6.50	7.50
S-W	6.00	0.00	0.00	5.00	6.00	6.50	7.50
-LD	1057.00	2.00	2114.00	5.00	6.00	6.50	7.50
-SD	4733.00	2.00	9466.00	5.00	6.00	6.50	7.50
-S	4591.00	6.00	27546.00	5.00	6.00	6.50	7.50
-O	1969.00	8.00	15752.00	5.00	6.00	6.50	7.50
-NF	1336.00	8.00	10688.00	5.00	6.00	6.50	7.50
-W	31.00	0.00	0.00	5.00	6.00	6.50	7.50
-LD	510.00	1.00	510.00	5.00	6.00	6.50	7.50
-SD	1276.00	1.00	1276.00	5.00	6.00	6.50	7.50
-S	833.00	3.00	2499.00	5.00	6.00	6.50	7.50
-O	622.00	4.00	2488.00	5.00	6.00	6.50	7.50
-NF	1984.00	4.00	7936.00	5.00	6.00	6.50	7.50
-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
=====							
TOTAL =	63369.00		267467.00				

[illegible]

SWE MODIFIED CM	AIR TEMP C	SE TEMP C	MODIFIED TEMP C	AVERAGE WIND SPEED M/S	UNUSUAL WIND SPEED M/S	FOREST COVER DECIMAL	MODIFIED AVERAGE WIND M/S
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
27.33	7.19	2.00	9.19	4.00	7.00	0.40	2.72
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
0.00	7.19	2.00	9.19	4.00	7.00	0.00	4.00
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
37.26	6.09	2.00	8.09	4.00	7.00	0.40	2.72
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
0.00	6.09	2.00	8.09	4.00	7.00	0.00	4.00
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
53.87	3.99	2.00	5.99	4.00	7.00	0.40	2.72
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
0.00	3.99	2.00	5.99	4.00	7.00	0.00	4.00
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
63.17	1.88	2.00	3.88	4.00	7.00	0.40	2.72
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.00	4.00
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.40	2.72
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.00	4.00

MODIFIED UNUSUAL WIND M/S	AVERAGE MELT P2 CM	AVERAGE MELT P5 CM	AVERAGE MELT P10 CM	AVERAGE MELT P25 CM	AVERAGE MELT P50 CM	AVERAGE MELT P100 CM	UNUSUAL MELT P2 CM
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
4.76	3.32	3.41	3.46	3.55	3.64	3.68	5.79
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
7.00	4.11	4.20	4.25	4.34	4.43	4.47	7.56
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
4.76	2.85	2.92	2.96	3.04	3.12	3.15	5.13
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
7.00	3.52	3.59	3.63	3.71	3.79	3.82	6.68
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
4.76	1.94	1.99	2.02	2.07	2.12	2.14	3.85
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
7.00	2.38	2.43	2.46	2.51	2.56	2.58	5.01
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
4.76	1.04	1.06	1.07	1.10	1.12	1.13	2.58
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
7.00	1.25	1.27	1.28	1.31	1.33	1.34	3.33
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
4.76	0.17	0.17	0.17	0.17	0.17	0.17	1.36
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
7.00	0.16	0.16	0.16	0.16	0.15	0.15	1.72

UNUSUAL MELT P5 CM	UNUSUAL MELT P10 CM	UNUSUAL MELT P25 CM	UNUSUAL MELT P50 CM	UNUSUAL MELT P100 CM	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
5.91	5.96	6.08	6.20	6.25	6.31	7.34	7.86
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.68	7.73	7.85	7.97	8.02	6.62	7.65	8.17
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
5.23	5.28	5.38	5.48	5.53	6.12	7.15	7.67
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.79	6.84	6.94	7.04	7.09	6.38	7.42	7.93
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
3.93	3.97	4.04	4.12	4.15	5.77	6.78	7.29
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
5.08	5.12	5.19	5.27	5.31	5.94	6.96	7.47
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
2.63	2.65	2.70	2.75	2.78	5.41	6.42	6.92
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.38	3.40	3.45	3.50	3.52	5.49	6.50	7.00
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
1.39	1.40	1.42	1.45	1.46	5.07	6.07	6.57
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.75	1.76	1.78	1.81	1.82	5.06	6.06	6.56

Average Input = 5.60 6.62 7.13

Peak Flow = 12007.81 15935.80 17899.79

P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN	P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.90	9.93	10.45	7.28	8.33	8.85	9.89	10.94
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.21	10.24	10.76	7.98	9.02	9.54	10.59	11.64
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.70	9.73	10.24	7.02	8.06	8.58	9.62	10.66
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.96	9.99	10.51	7.63	8.67	9.19	10.23	11.27
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.31	9.33	9.84	6.52	7.55	8.06	9.09	10.12
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.49	9.51	10.02	6.97	8.00	8.52	9.55	10.57
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.93	8.94	9.45	6.02	7.04	7.54	8.56	9.58
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.01	9.02	9.53	6.31	7.33	7.84	8.86	9.88
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.54	6.55	7.05	8.06	9.07
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.68	6.69	7.19	8.20	9.21
8.16	9.18	9.69	6.05	7.08	7.59	8.62	9.66
21827.78	25755.76	27719.76	13716.79	17682.94	19666.02	23632.17	27598.32

*****					AREA WEIGHTED		*****
P100 + UNUSUAL MELT IN	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN	P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN
10.68	0.01	0.01	0.01	0.01	0.01	0.01	0.01
10.68	0.20	0.24	0.25	0.29	0.32	0.34	0.22
11.46	0.17	0.20	0.21	0.24	0.26	0.28	0.19
12.04	0.17	0.20	0.22	0.24	0.27	0.28	0.21
12.04	0.06	0.06	0.07	0.08	0.09	0.09	0.07
12.16	0.01	0.02	0.02	0.02	0.02	0.02	0.02
10.49	0.01	0.02	0.02	0.02	0.02	0.02	0.02
10.49	1.29	1.52	1.63	1.86	2.09	2.20	1.40
11.18	0.23	0.26	0.28	0.32	0.36	0.38	0.26
11.68	0.38	0.44	0.47	0.54	0.60	0.63	0.45
11.68	0.11	0.13	0.14	0.16	0.17	0.18	0.13
11.79	0.11	0.13	0.14	0.16	0.17	0.18	0.13
10.13	0.02	0.03	0.03	0.03	0.04	0.04	0.03
10.13	0.78	0.93	1.00	1.14	1.29	1.36	0.85
10.64	0.48	0.57	0.61	0.70	0.78	0.82	0.54
11.01	0.05	0.06	0.07	0.08	0.09	0.09	0.06
11.01	0.06	0.07	0.07	0.08	0.09	0.09	0.07
11.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.76	0.09	0.11	0.11	0.13	0.15	0.16	0.09
9.76	0.40	0.47	0.51	0.59	0.66	0.70	0.42
10.09	0.39	0.47	0.50	0.57	0.65	0.68	0.44
10.34	0.17	0.20	0.22	0.25	0.28	0.30	0.19
10.34	0.12	0.14	0.15	0.17	0.19	0.20	0.13
10.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.41	0.04	0.05	0.05	0.06	0.07	0.07	0.04
9.41	0.10	0.12	0.13	0.15	0.17	0.18	0.11
9.57	0.07	0.08	0.09	0.10	0.11	0.12	0.07
9.69	0.05	0.06	0.06	0.07	0.08	0.09	0.06
9.69	0.16	0.19	0.21	0.24	0.27	0.28	0.18
9.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.17	5.73	6.75	7.26	8.29	9.31	9.82	6.39
29581.39	12506.21	16434.19	18398.19	22326.17	26254.16	28218.15	15021.87

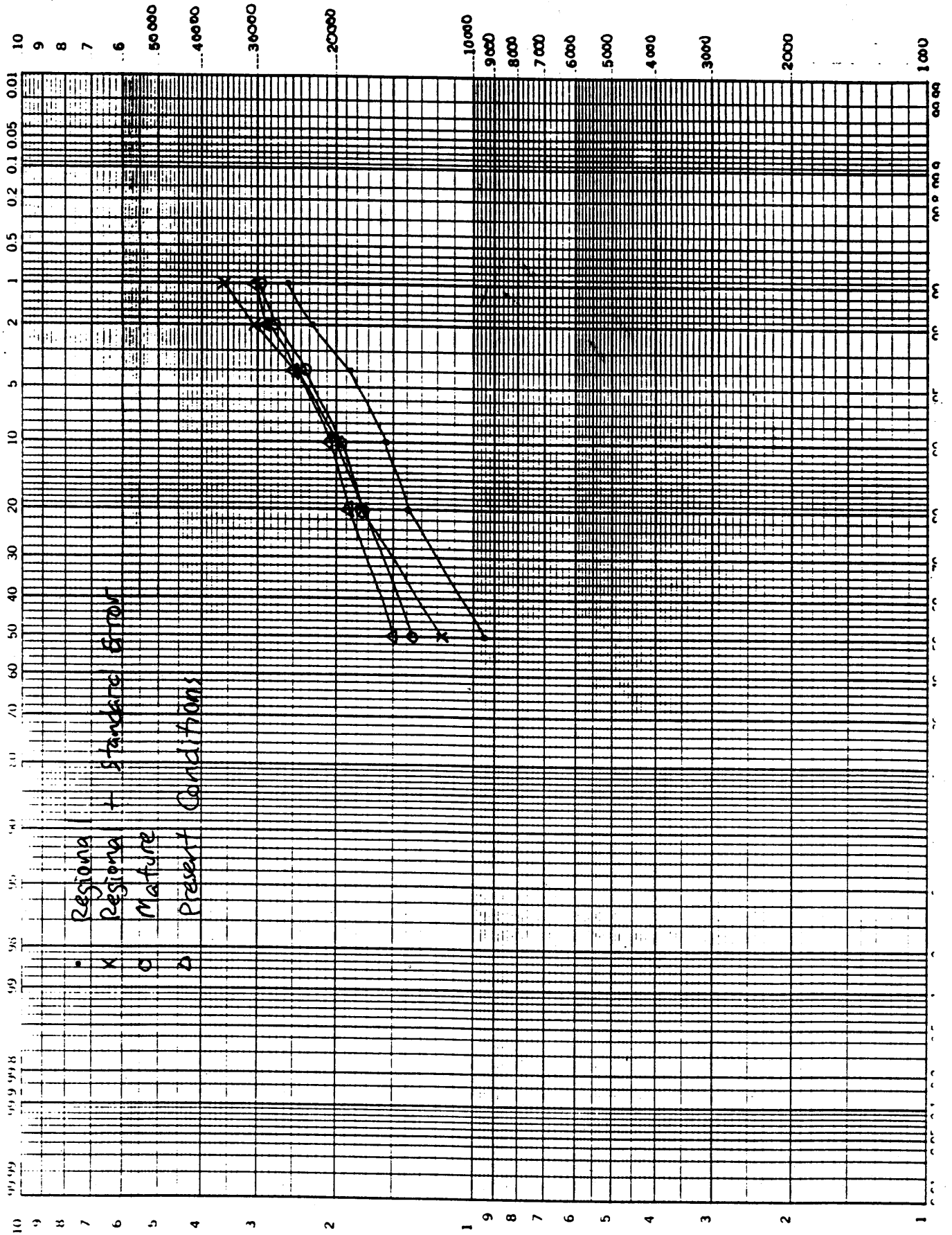
P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN	P100 + UNUSUAL MELT IN
0.01	0.01	0.01	0.01	0.01
0.25	0.27	0.31	0.34	0.36
0.22	0.24	0.26	0.29	0.31
0.24	0.25	0.28	0.31	0.32
0.07	0.08	0.09	0.10	0.10
0.02	0.02	0.02	0.02	0.02
0.02	0.02	0.02	0.02	0.03
1.63	1.75	1.98	2.21	2.32
0.30	0.32	0.36	0.39	0.41
0.51	0.55	0.61	0.67	0.70
0.15	0.16	0.18	0.20	0.21
0.15	0.16	0.18	0.20	0.21
0.03	0.03	0.04	0.04	0.04
0.99	1.06	1.21	1.35	1.42
0.63	0.67	0.76	0.85	0.89
0.07	0.08	0.09	0.09	0.10
0.07	0.08	0.09	0.10	0.10
0.00	0.00	0.00	0.00	0.00
0.11	0.12	0.14	0.15	0.16
0.50	0.54	0.61	0.69	0.73
0.51	0.55	0.62	0.69	0.73
0.23	0.24	0.27	0.31	0.32
0.15	0.16	0.19	0.21	0.22
0.00	0.00	0.00	0.00	0.01
0.05	0.06	0.06	0.07	0.08
0.13	0.14	0.16	0.18	0.19
0.09	0.09	0.11	0.12	0.13
0.07	0.07	0.08	0.09	0.10
0.21	0.22	0.26	0.29	0.30
0.00	0.00	0.00	0.00	0.00
7.42	7.93	8.96	10.00	10.51

18988.02 20971.09 24937.24 28903.39 30886.47

Sub-basins 1-14

46 8040

Fig. 2. PROBABILITY AND LOG-CYCLES
STANDARDIZATION OF SUB-BASINS



Sub-basin 1-7, 10-14

Regional Flood Frequency Worksheet for Tolt River
 -basins 1-7, 10-14
 based on Region I

Recurrence Interval	Regress constant	Area (mi2)	Area exponent	Ann Precip (in)	Precip exponent	Forest cover	For Cover exponent
2	0.191	80.48	0.86	94.00	1.51	1.00	1.00
5	0.257	80.48	0.86	94.00	1.53	1.00	1.00
10	0.288	80.48	0.85	94.00	1.54	1.00	1.00
25	0.317	80.48	0.85	94.00	1.56	1.00	1.00
50	0.332	80.48	0.86	94.00	1.58	1.00	1.00
100	0.343	80.48	0.86	94.00	1.60	1.00	1.00

-basins 1-7, 10-14

Q est (ft ³ /s)	Standard error (%)	Q + SE
7,931.21	24.90	9,906.08
11,686.96	24.60	14,561.96
13,117.03	26.90	16,645.51
15,811.20	31.50	20,791.73
18,947.99	35.70	25,712.42
21,437.87	40.30	30,077.33

Level 1 Analysis
Sub-basin 1-7, 10-14

INPUT INFORMATION

Return Period	Peak Flow (cfs)	24-hour Rainfall (in)	Regress. Peak Flow (cfs)
2	7931.00	5.00	8116.57
5	11687.00	6.00	11335.10
10	13117.00	6.50	12944.36
25	15811.00	7.50	16162.89
50	18947.00	8.50	19381.41
100	21438.00	9.00	20990.68

Regression intercept = -7976.06
Regression slope = 3218.53

Elevation of Zones

Elevation of Lowland =	500 (ft)
Elevation of Rain Dominated =	1100 (ft)
Elevation of Rain on Snow =	2250 (ft)
Elevation of Snow Dominated =	3400 (ft)
Elevation of Highland =	4500 (ft)

Snow Water Equivalent vs Elevation Relationship

Constant =	-3.970 (cm)
Slope =	0.042 (cm/m)
Standard Error =	11.278 (cm)

Air Temperature vs Elevation Relationship

Constant =	8.100 (C)
Slope =	-0.006 (C/m)
Standard Error =	2.000 (C)

Wind Speed

Average Wind Speed =	4 (m/s)
Unusual Wind Speed =	7 (m/s)

Level 1 Analysis

SUMMARY INFORMATION

Basin Score = 4.1455946

Worst Basin Score = 8.2406709

Best Basin Score = 2.0601677

Area in Lowland	6221	0.12
Area in Rain Dominated	21138	0.41
Area in Rain on Snow	12250	0.24
Area in Snow Dominated	8967	0.17
Area in Highland	2930	0.06
=====		
TOTAL =	51506	1

Area in Large Dense	1711	0.03
Area in Small Dense	27113	0.53
Area in Sparse	11138	0.22
Area in Open	7593	0.15
Area in Non-Forest	3748	0.07
Area in Water	203	0.00
=====		
TOTAL =	51506	1

Level 1 Analysis

Precip Zone- Veg Class	Area (acres)	Precip- Veg Score	Score X Area	P2	P5	P10	P25
L-LD	58.00	1.00	58.00	5.00	6.00	6.50	7.50
L-SD	2134.00	1.00	2134.00	5.00	6.00	6.50	7.50
L-S	1690.00	3.00	5070.00	5.00	6.00	6.50	7.50
L-O	1682.00	4.00	6728.00	5.00	6.00	6.50	7.50
L-NF	531.00	4.00	2124.00	5.00	6.00	6.50	7.50
L-W	126.00	0.00	0.00	5.00	6.00	6.50	7.50
R-LD	155.00	2.00	310.00	5.00	6.00	6.50	7.50
R-SD	13738.00	2.00	27476.00	5.00	6.00	6.50	7.50
R-S	2287.00	6.00	13722.00	5.00	6.00	6.50	7.50
R-O	3806.00	8.00	30448.00	5.00	6.00	6.50	7.50
R-NF	1095.00	8.00	8760.00	5.00	6.00	6.50	7.50
R-W	57.00	0.00	0.00	5.00	6.00	6.50	7.50
RS-LD	264.00	3.00	792.00	5.00	6.00	6.50	7.50
RS-SD	7241.00	3.00	21723.00	5.00	6.00	6.50	7.50
RS-S	3822.00	9.00	34398.00	5.00	6.00	6.50	7.50
RS-O	505.00	12.00	6060.00	5.00	6.00	6.50	7.50
F NF	412.00	12.00	4944.00	5.00	6.00	6.50	7.50
RJ-W	6.00	0.00	0.00	5.00	6.00	6.50	7.50
S-LD	887.00	2.00	1774.00	5.00	6.00	6.50	7.50
S-SD	3296.00	2.00	6592.00	5.00	6.00	6.50	7.50
S-S	2978.00	6.00	17868.00	5.00	6.00	6.50	7.50
S-O	1153.00	8.00	9224.00	5.00	6.00	6.50	7.50
S-NF	639.00	8.00	5112.00	5.00	6.00	6.50	7.50
S-W	14.00	0.00	0.00	5.00	6.00	6.50	7.50
H-LD	347.00	1.00	347.00	5.00	6.00	6.50	7.50
H-SD	704.00	1.00	704.00	5.00	6.00	6.50	7.50
H-S	361.00	3.00	1083.00	5.00	6.00	6.50	7.50
H-O	447.00	4.00	1788.00	5.00	6.00	6.50	7.50
H-NF	1071.00	4.00	4284.00	5.00	6.00	6.50	7.50
H-W	0.00	0.00	0.00	5.00	6.00	6.50	7.50
=====							
TOTAL =	51506.00		213523.00				

[illegible]

SWE MODIFIED CM	AIR TEMP C	SE TEMP C	MODIFIED TEMP C	AVERAGE WIND SPEED M/S	UNUSUAL WIND SPEED M/S	FOREST COVER DECIMAL	MODIFIED AVERAGE WIND M/S
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
13.67	7.19	2.00	9.19	4.00	7.00	0.85	1.28
27.33	7.19	2.00	9.19	4.00	7.00	0.40	2.72
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
41.00	7.19	2.00	9.19	4.00	7.00	0.07	3.78
0.00	7.19	2.00	9.19	4.00	7.00	0.00	4.00
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
21.29	6.09	2.00	8.09	4.00	7.00	0.85	1.28
37.26	6.09	2.00	8.09	4.00	7.00	0.40	2.72
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
53.23	6.09	2.00	8.09	4.00	7.00	0.07	3.78
0.00	6.09	2.00	8.09	4.00	7.00	0.00	4.00
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
35.91	3.99	2.00	5.99	4.00	7.00	0.85	1.28
53.87	3.99	2.00	5.99	4.00	7.00	0.40	2.72
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
71.83	3.99	2.00	5.99	4.00	7.00	0.07	3.78
0.00	3.99	2.00	5.99	4.00	7.00	0.00	4.00
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
50.54	1.88	2.00	3.88	4.00	7.00	0.85	1.28
63.17	1.88	2.00	3.88	4.00	7.00	0.40	2.72
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.07	3.78
75.80	1.88	2.00	3.88	4.00	7.00	0.00	4.00
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.85	1.28
64.52	-0.13	2.00	1.87	4.00	7.00	0.40	2.72
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.07	3.78
64.52	-0.13	2.00	1.87	4.00	7.00	0.00	4.00

MODIFIED UNUSUAL WIND M/S	AVERAGE MELT P2 CM	AVERAGE MELT P5 CM	AVERAGE MELT P10 CM	AVERAGE MELT P25 CM	AVERAGE MELT P50 CM	AVERAGE MELT P100 CM	UNUSUAL MELT P2 CM
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
2.24	2.43	2.52	2.57	2.66	2.75	2.79	3.80
4.76	3.32	3.41	3.46	3.55	3.64	3.68	5.79
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
6.61	3.97	4.06	4.11	4.20	4.29	4.33	7.25
7.00	4.11	4.20	4.25	4.34	4.43	4.47	7.56
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
2.24	2.09	2.17	2.21	2.29	2.36	2.40	3.37
4.76	2.85	2.92	2.96	3.04	3.12	3.15	5.13
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
6.61	3.40	3.48	3.52	3.59	3.67	3.71	6.41
7.00	3.52	3.59	3.63	3.71	3.79	3.82	6.68
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
2.24	1.45	1.50	1.53	1.58	1.63	1.65	2.56
4.76	1.94	1.99	2.02	2.07	2.12	2.14	3.85
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
6.61	2.31	2.36	2.38	2.43	2.48	2.51	4.80
7.00	2.38	2.43	2.46	2.51	2.56	2.58	5.01
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
2.24	0.81	0.83	0.84	0.87	0.89	0.90	1.74
4.76	1.04	1.06	1.07	1.10	1.12	1.13	2.58
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
6.61	1.21	1.23	1.25	1.27	1.29	1.31	3.20
7.00	1.25	1.27	1.28	1.31	1.33	1.34	3.33
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
2.24	0.19	0.19	0.19	0.19	0.18	0.18	0.96
4.76	0.17	0.17	0.17	0.17	0.17	0.17	1.36
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
6.61	0.16	0.16	0.16	0.16	0.16	0.16	1.66
7.00	0.16	0.16	0.16	0.16	0.15	0.15	1.72

UNUSUAL MELT P5 CM	UNUSUAL MELT P10 CM	UNUSUAL MELT P25 CM	UNUSUAL MELT P50 CM	UNUSUAL MELT P100 CM	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
3.92	3.97	4.09	4.20	4.26	5.96	6.99	7.51
5.91	5.96	6.08	6.20	6.25	6.31	7.34	7.86
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.37	7.42	7.54	7.66	7.71	6.56	7.60	8.12
7.68	7.73	7.85	7.97	8.02	6.62	7.65	8.17
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
3.48	3.53	3.63	3.73	3.78	5.82	6.85	7.37
5.23	5.28	5.38	5.48	5.53	6.12	7.15	7.67
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.51	6.56	6.67	6.77	6.82	6.34	7.37	7.88
6.79	6.84	6.94	7.04	7.09	6.38	7.42	7.93
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
2.63	2.67	2.74	2.82	2.86	5.57	6.59	7.10
3.93	3.97	4.04	4.12	4.15	5.77	6.78	7.29
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
4.88	4.92	4.99	5.07	5.11	5.91	6.93	7.44
5.08	5.12	5.19	5.27	5.31	5.94	6.96	7.47
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
1.79	1.81	1.86	1.91	1.93	5.32	6.33	6.83
2.63	2.65	2.70	2.75	2.78	5.41	6.42	6.92
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.25	3.27	3.32	3.37	3.39	5.48	6.49	6.99
3.38	3.40	3.45	3.50	3.52	5.49	6.50	7.00
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
0.98	0.99	1.02	1.04	1.05	5.07	6.07	6.57
1.39	1.40	1.42	1.45	1.46	5.07	6.07	6.57
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.68	1.70	1.72	1.74	1.75	5.06	6.06	6.56
1.75	1.76	1.78	1.81	1.82	5.06	6.06	6.56

Average Input = 5.65 6.67 7.18

Peak Flow = 10205.60 13498.13 15144.39

P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN	P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.55	9.58	10.10	6.50	7.54	8.06	9.11	10.16
8.90	9.93	10.45	7.28	8.33	8.85	9.89	10.94
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.15	10.19	10.71	7.85	8.90	9.42	10.47	11.51
9.21	10.24	10.76	7.98	9.02	9.54	10.59	11.64
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.40	9.43	9.95	6.33	7.37	7.89	8.93	9.97
8.70	9.73	10.24	7.02	8.06	8.58	9.62	10.66
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.91	9.94	10.46	7.52	8.56	9.08	10.12	11.16
8.96	9.99	10.51	7.63	8.67	9.19	10.23	11.27
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.12	9.14	9.65	6.01	7.04	7.55	8.58	9.61
8.31	9.33	9.84	6.52	7.55	8.06	9.09	10.12
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.46	9.48	9.99	6.89	7.92	8.44	9.47	10.50
8.49	9.51	10.02	6.97	8.00	8.52	9.55	10.57
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.84	8.85	9.35	5.68	6.70	7.21	8.23	9.25
7.93	8.94	9.45	6.02	7.04	7.54	8.56	9.58
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.00	9.01	9.51	6.26	7.28	7.79	8.81	9.83
8.01	9.02	9.53	6.31	7.33	7.84	8.86	9.88
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.38	6.39	6.89	7.90	8.91
7.57	8.57	9.07	5.54	6.55	7.05	8.06	9.07
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.65	6.66	7.17	8.18	9.19
7.56	8.56	9.06	5.68	6.69	7.19	8.20	9.21
8.21	9.23	9.74	6.11	7.14	7.66	8.69	9.72
18436.92	21729.44	23375.70	11675.39	14999.85	16662.08	19986.54	23310.99

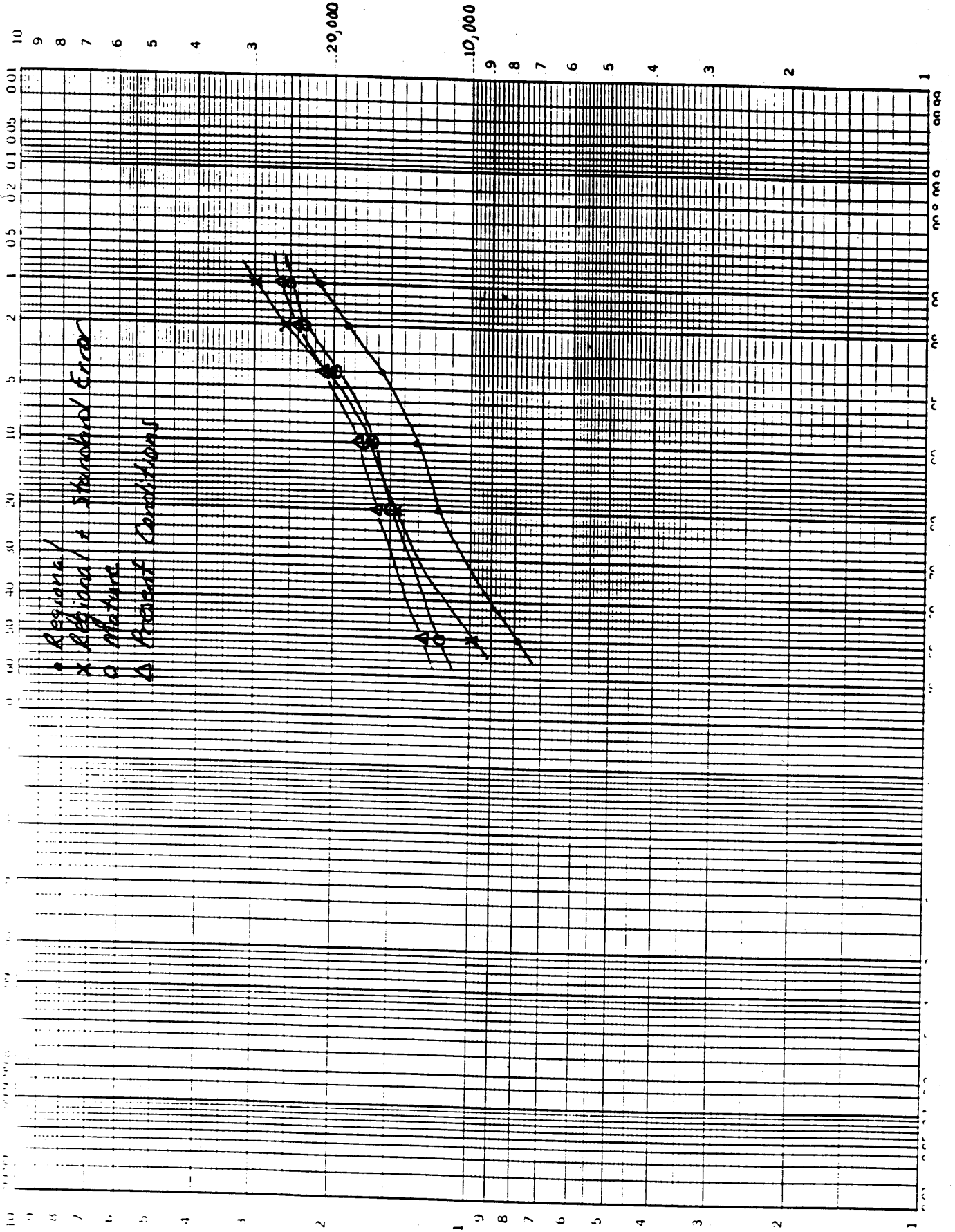
AREA WEIGHTED

P100 + UNUSUAL MELT IN	P2 + AVERAGE MELT IN	P5 + AVERAGE MELT IN	P10 + AVERAGE MELT IN	P25 + AVERAGE MELT IN	P50 + AVERAGE MELT IN	P100 + AVERAGE MELT IN	P2 + UNUSUAL MELT IN
10.68	0.01	0.01	0.01	0.01	0.01	0.01	0.01
10.68	0.25	0.29	0.31	0.35	0.40	0.42	0.27
11.46	0.21	0.24	0.26	0.29	0.33	0.34	0.24
12.04	0.21	0.25	0.27	0.30	0.33	0.35	0.26
12.04	0.07	0.08	0.08	0.09	0.11	0.11	0.08
12.16	0.02	0.02	0.02	0.02	0.03	0.03	0.02
10.49	0.02	0.02	0.02	0.03	0.03	0.03	0.02
10.49	1.55	1.83	1.97	2.24	2.52	2.65	1.69
11.18	0.27	0.32	0.34	0.39	0.43	0.45	0.31
11.68	0.47	0.54	0.58	0.66	0.73	0.77	0.56
11.68	0.13	0.16	0.17	0.19	0.21	0.22	0.16
11.79	0.01	0.01	0.01	0.01	0.01	0.01	0.01
10.13	0.03	0.03	0.04	0.04	0.05	0.05	0.03
10.13	0.78	0.93	1.00	1.14	1.28	1.36	0.84
10.64	0.43	0.50	0.54	0.62	0.69	0.73	0.48
11.01	0.06	0.07	0.07	0.08	0.09	0.10	0.07
11.01	0.05	0.06	0.06	0.07	0.08	0.08	0.06
11.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.76	0.09	0.11	0.12	0.14	0.15	0.16	0.10
9.76	0.34	0.40	0.44	0.50	0.57	0.60	0.36
10.09	0.31	0.37	0.40	0.46	0.52	0.55	0.35
10.34	0.12	0.15	0.16	0.18	0.20	0.21	0.14
10.34	0.07	0.08	0.09	0.10	0.11	0.12	0.08
10.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.41	0.03	0.04	0.04	0.05	0.06	0.06	0.04
9.41	0.07	0.08	0.09	0.10	0.12	0.12	0.07
9.57	0.04	0.04	0.05	0.05	0.06	0.06	0.04
9.69	0.04	0.05	0.06	0.07	0.07	0.08	0.05
9.69	0.11	0.13	0.14	0.16	0.18	0.19	0.12
9.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.24	5.78	6.81	7.32	8.34	9.36	9.87	6.44
24973.22	10633.50	13926.02	15572.28	18864.81	22157.34	23803.60	12756.68

P5 + UNUSUAL MELT IN	P10 + UNUSUAL MELT IN	P25 + UNUSUAL MELT IN	P50 + UNUSUAL MELT IN	P100 + UNUSUAL MELT IN
0.01	0.01	0.01	0.01	0.01
0.31	0.33	0.38	0.42	0.44
0.27	0.29	0.32	0.36	0.38
0.29	0.31	0.34	0.38	0.39
0.09	0.10	0.11	0.12	0.12
0.02	0.02	0.03	0.03	0.03
0.02	0.02	0.03	0.03	0.03
1.97	2.10	2.38	2.66	2.80
0.36	0.38	0.43	0.47	0.50
0.63	0.67	0.75	0.83	0.86
0.18	0.19	0.22	0.24	0.25
0.01	0.01	0.01	0.01	0.01
0.04	0.04	0.04	0.05	0.05
0.99	1.06	1.21	1.35	1.42
0.56	0.60	0.67	0.75	0.79
0.08	0.08	0.09	0.10	0.11
0.06	0.07	0.08	0.08	0.09
0.00	0.00	0.00	0.00	0.00
0.12	0.12	0.14	0.16	0.17
0.43	0.46	0.53	0.59	0.62
0.41	0.44	0.50	0.55	0.58
0.16	0.17	0.20	0.22	0.23
0.09	0.10	0.11	0.12	0.13
0.00	0.00	0.00	0.00	0.00
0.04	0.05	0.05	0.06	0.06
0.09	0.09	0.11	0.12	0.13
0.05	0.05	0.06	0.06	0.07
0.06	0.06	0.07	0.08	0.08
0.14	0.15	0.17	0.19	0.20
0.00	0.00	0.00	0.00	0.00
7.47	7.99	9.02	10.06	10.57
16081.14	17743.37	21067.83	24392.28	26054.51

Sub-basins 1-7, 10-14

46 8040



	1	2	3	4	5	6
L-LD	1.00					
L-SD	1.00					
L-S	3.00					
L-O	4.00					
L-NF	4.00					
L-W	0.00					
R-LD	2.00	0.00	0.00	2.00	14.00	0.00
R-SD	2.00	0.00	521.00	408.00	2,796.00	0.00
R-S	6.00	7.00	115.00	89.00	46.00	696.00
R-O	8.00	0.00	0.00	0.00	731.00	91.00
R-NF	8.00	0.00	57.00	3.00	150.00	27.00
R-W	0.00	0.00	0.00	0.00	0.00	46.00
RS-LD	3.00	0.00	39.00	154.00	34.00	21.00
RS-SD	3.00	361.00	0.00	1,406.00	650.00	2,917.00
RS-S	9.00	71.00	200.00	1,729.00	333.00	1,012.00
RS-O	12.00	30.00	10.00	258.00	78.00	81.00
RS-NF	12.00	16.00	0.00	205.00	62.00	84.00
RS-W	0.00	0.00	0.00	0.00	0.00	6.00
S-LD	2.00	0.00	56.00	755.00	70.00	2.00
S-SD	2.00	699.00	0.00	1,490.00	287.00	179.00
S-S	6.00	46.00	185.00	1,306.00	116.00	905.00
S-O	8.00	8.00	265.00	671.00	155.00	54.00
S-NF	8.00	266.00	0.00	252.00	119.00	0.00
S-W	0.00	0.00	0.00	14.00	0.00	0.00
J D	1.00	0.00	2.00	267.00	78.00	
H-SD	1.00	247.00	0.00	448.00	0.00	
H-S	3.00	18.00	84.00	257.00	2.00	
H-O	4.00	0.00	70.00	347.00	30.00	
H-NF	4.00	465.00	0.00	547.00	59.00	
H-W	0.00	0.00	0.00	0.00	0.00	
	2,227.00	918.00	10,799.00	2,575.00	8,998.00	860.00

7	8	9	10	11	12	13	14
---	---	---	----	----	----	----	----

0.00							58.00
102.00							2,032.00
88.00							1,602.00
197.00							1,485.00
63.00							468.00
8.00							118.00
2.00	0.00	0.00	50.00	0.00	78.00	8.00	1.00
1,499.00	88.00	193.00	1,813.00	1,270.00	795.00	3,613.00	1,023.00
477.00	30.00	22.00	75.00	121.00	136.00	282.00	243.00
1,071.00	0.00	0.00	478.00	398.00	348.00	545.00	144.00
121.00	20.00	0.00	137.00	134.00	51.00	354.00	61.00
5.00	0.00	1,047.00	0.00	0.00	0.00	6.00	0.00
	7.00	2.00	16.00	0.00		0.00	
	283.00	1,394.00	646.00	752.00		509.00	
	1,085.00	392.00	265.00	17.00		195.00	
	2.00	66.00	0.00	0.00		48.00	
	116.00	71.00	37.00	0.00		8.00	
	0.00	0.00	0.00	0.00		0.00	
	100.00	70.00	4.00	0.00			
	828.00	609.00	48.00	593.00			
	477.00	1,136.00	340.00	80.00			
	162.00	654.00	0.00	0.00			
	615.00	82.00	0.00	2.00			
	17.00	0.00	0.00	0.00			
	53.00	110.00		0.00			
	521.00	51.00		9.00			
	108.00	364.00		0.00			
	26.00	149.00		0.00			
	888.00	25.00		0.00			
	0.00	0.00		0.00			

3,633.00	5,426.00	6,437.00	3,909.00	3,376.00	1,408.00	5,568.00	7,235.00
----------	----------	----------	----------	----------	----------	----------	----------

1234	12345	1-6	1-6 13	89	891011	8-12	1-13
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	102.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	88.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	197.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	63.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00
2.00	16.00	16.00	24.00	0.00	50.00	128.00	154.00
929.00	3,725.00	3,725.00	7,338.00	281.00	3,364.00	4,159.00	12,996.00
211.00	257.00	953.00	1,235.00	52.00	248.00	384.00	2,096.00
0.00	731.00	822.00	1,367.00	0.00	876.00	1,224.00	3,662.00
60.00	210.00	237.00	591.00	20.00	291.00	342.00	1,054.00
0.00	0.00	46.00	52.00	1,047.00	1,047.00	1,047.00	1,104.00
227.00	248.00	248.00	248.00	9.00	25.00	25.00	273.00
2,417.00	5,334.00	5,334.00	5,843.00	1,677.00	3,075.00	3,075.00	8,918.00
2,333.00	3,345.00	3,345.00	3,540.00	1,477.00	1,759.00	1,759.00	5,299.00
376.00	457.00	457.00	505.00	68.00	68.00	68.00	573.00
283.00	367.00	367.00	375.00	187.00	224.00	224.00	599.00
0.00	6.00	6.00	6.00	0.00	0.00	0.00	6.00
881.00	883.00	883.00	883.00	170.00	174.00	174.00	1,057.00
2,476.00	2,655.00	2,655.00	2,655.00	1,437.00	2,078.00	2,078.00	4,733.00
1,653.00	2,558.00	2,558.00	2,558.00	1,613.00	2,033.00	2,033.00	4,591.00
1,099.00	1,153.00	1,153.00	1,153.00	816.00	816.00	816.00	1,969.00
637.00	637.00	637.00	637.00	697.00	699.00	699.00	1,336.00
14.00	14.00	14.00	14.00	17.00	17.00	17.00	31.00
347.00	347.00	347.00	347.00	163.00	163.00	163.00	510.00
695.00	695.00	695.00	695.00	572.00	581.00	581.00	1,276.00
361.00	361.00	361.00	361.00	472.00	472.00	472.00	833.00
447.00	447.00	447.00	447.00	175.00	175.00	175.00	622.00
1,071.00	1,071.00	1,071.00	1,071.00	913.00	913.00	913.00	1,984.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

16,519.00 25,517.00 26,377.00 31,945.00 11,863.00 19,148.00 20,556.00 56,134.00

-14

1-710-14

58.00	58.00
2,134.00	2,134.00
1,690.00	1,690.00
1,682.00	1,682.00
531.00	531.00
126.00	126.00
155.00	155.00
14,019.00	13,738.00
2,339.00	2,287.00
3,806.00	3,806.00
1,115.00	1,095.00
1,104.00	57.00
273.00	264.00
8,918.00	7,241.00
5,299.00	3,822.00
573.00	505.00
599.00	412.00
6.00	6.00
1,057.00	887.00
4,733.00	3,296.00
4,591.00	2,978.00
1,969.00	1,153.00
1,336.00	639.00
31.00	14.00
510.00	347.00
- ,276.00	704.00
833.00	361.00
622.00	447.00
1,984.00	1,071.00
0.00	0.00

63,369.00 51,506.00

RAW STREAMFLOW DATA

STATION 121400000 TOUT RIVER OF AG CARRIAGE, WASH.

HIGHEST MEAN FLOW IN CFS FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING SEPT. 30

YEAR	1 DAY	3 DAYS	7 DAYS	15 DAYS	30 DAYS	60 DAYS	90 DAYS	120 DAYS	180 DAYS	ANNUAL PEAK-FLOW DATA FLOW (CFS) DATE REG. (IN)
1929	4200	1800	1100	1020	910	870	787	734	557	4090 10/09/28
1930	2000	1600	1500	1530	1190	896	791	739	667	
1931	2330	1700	1500	1100	1000	810	780	719	624	3250 10/26/30
1932	6000	4000	2810	1720	1400	1250	1100	943	870	10600 04/18/38
1933	1820	2020	1620	1320	1100	917	855	814	899	4600 11/16/38
1934	3000	2000	1620	1320	1100	857	824	802	798	4600 11/07/39
1935	3200	2000	1620	1320	1100	857	824	802	798	8250 11/28/40
1936	3410	2120	1530	1210	978	758	754	684	607	5190 12/19/41
1937	3410	2120	1530	1210	978	758	754	684	607	12300 10/31/42
1938	3410	2120	1530	1210	978	758	754	684	607	9210 12/02/43
1939	3410	2120	1530	1210	978	758	754	684	607	12700 01/07/45
1940	3410	2120	1530	1210	978	758	754	684	607	4960 10/25/46
1941	3410	2120	1530	1210	978	758	754	684	607	8450 10/25/46
1942	3410	2120	1530	1210	978	758	754	684	607	7720 10/19/47
1943	3410	2120	1530	1210	978	758	754	684	607	7250 11/23/48
1944	3410	2120	1530	1210	978	758	754	684	607	10600 03/04/50
1945	3410	2120	1530	1210	978	758	754	684	607	16800 02/09/51
1946	3410	2120	1530	1210	978	758	754	684	607	4890 02/04/52
1947	3410	2120	1530	1210	978	758	754	684	607	10000 01/23/53
1948	3410	2120	1530	1210	978	758	754	684	607	9870 12/08/53
1949	3410	2120	1530	1210	978	758	754	684	607	9190 02/08/55
1950	3410	2120	1530	1210	978	758	754	684	607	15000 12/11/55
1951	3410	2120	1530	1210	978	758	754	684	607	6780 12/10/56
1952	3410	2120	1530	1210	978	758	754	684	607	3840 01/17/58
1953	3410	2120	1530	1210	978	758	754	684	607	8960 11/20/58
1954	3410	2120	1530	1210	978	758	754	684	607	17400 12/15/59
1955	3410	2120	1530	1210	978	758	754	684	607	8200 02/21/61
1956	3410	2120	1530	1210	978	758	754	684	607	7400 01/07/62
1957	3410	2120	1530	1210	978	758	754	684	607	10200 11/19/62
1958	3410	2120	1530	1210	978	758	754	684	607	3960 01/01/64
1959	3410	2120	1530	1210	978	758	754	684	607	6500 01/29/65
1960	3410	2120	1530	1210	978	758	754	684	607	2260 01/13/66
1961	3410	2120	1530	1210	978	758	754	684	607	3780 12/25/67
1962	3410	2120	1530	1210	978	758	754	684	607	6900 01/05/69
1963	3410	2120	1530	1210	978	758	754	684	607	10300 10/01/69
1964	3410	2120	1530	1210	978	758	754	684	607	3320 01/19/71
1965	3410	2120	1530	1210	978	758	754	684	607	6250 11/04/71
1966	3410	2120	1530	1210	978	758	754	684	607	7580 12/26/72
1967	3410	2120	1530	1210	978	758	754	684	607	4290 01/24/74
1968	3410	2120	1530	1210	978	758	754	684	607	7120 01/17/75
1969	3410	2120	1530	1210	978	758	754	684	607	8560 12/02/75
1970	3410	2120	1530	1210	978	758	754	684	607	3020 01/18/77
1971	3410	2120	1530	1210	978	758	754	684	607	6920 12/02/77
1972	3410	2120	1530	1210	978	758	754	684	607	2880 12/24/78
1973	3410	2120	1530	1210	978	758	754	684	607	
1974	3410	2120	1530	1210	978	758	754	684	607	
1975	3410	2120	1530	1210	978	758	754	684	607	
1976	3410	2120	1530	1210	978	758	754	684	607	
1977	3410	2120	1530	1210	978	758	754	684	607	
1978	3410	2120	1530	1210	978	758	754	684	607	
1979	3410	2120	1530	1210	978	758	754	684	607	

HIGHEST MEAN FLOW AND ANNUAL PEAK FLOW STATISTICS (YEARS 1929-1979)

H R C SYSTEMATIC
ESTIMATE RECORD

MEAN	4701.8	1238.2	2261.0	1717.7	1375.4	1121.5	1007.1	910.3	813.3
MAXIMUM	11400.0	7200.0	4170.0	2720.0	2300.0	1760.0	1540.0	1320.0	1220.0
MINIMUM	1850.0	1510.0	1140.0	758.0	621.0	587.0	533.0	491.0	488.0
STANDARD DEVIATION	2107.11	1275.79	715.23	470.92	382.37	266.78	230.34	195.02	166.25
SKEWNESS	1.076	1.011	0.611	0.135	0.367	0.027	0.049	-0.026	-0.111
STD ERROR OF SKEWNESS	0.354	0.354	0.354	0.147	0.147	0.159	0.105	0.071	0.019
SERIAL CORR COEFF	0.078	-0.015	-0.103	-0.219	-0.147	-0.147	-0.147	-0.147	-0.147
COEFF OF VARIATION	0.448	0.394	0.316	0.274	0.278	0.238	0.229	0.214	0.204
MEAN LOGS	3.632	3.479	3.333	3.218	3.121	3.037	2.991	2.949	2.901
STD DEVIATION LOGS	0.191	0.165	0.138	0.125	0.125	0.109	0.104	0.098	0.094
SKEWNESS LOGS	-0.001	0.127	-0.098	-0.426	-0.319	-0.458	-0.475	-0.509	-0.559
STD ERR SKEWNESS LOGS	0.354	0.354	0.354	0.354	0.354	0.354	0.354	0.354	0.354
SEM CORR COEFF LOGS	-0.024	-0.113	-0.113	-0.249	-0.182	-0.168	-0.111	-0.081	0.019
COEFF OF VAR LOGS	0.053	0.048	0.041	0.039	0.040	0.036	0.035	0.033	0.032

3.8272
0.2129
-0.11750

STATION 12147500 NORTH FORK TULI RIVER NEAR CANNATION, WASH.

HIGHEST MEAN FLOW IN CFS FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING SEPT. 30

YEAR	1 DAY	7 DAYS	15 DAYS	30 DAYS	60 DAYS	90 DAYS	120 DAYS	183 DAYS	ANNUAL PEAK-FLOW DATA
									FLOW (CFS) DATE REG. (IN)
1953	4700.	2750.	1750.	1120.	880.	689.	620.	543.	5850. 01/23/53
1954	3610.	1950.	1420.	943.	760.	663.	520.	520.	5310. 12/09/53
1955	2880.	1680.	1010.	836.	669.	606.	546.	465.	4648. 02/07/55
1956	3700.	2200.	1220.	1060.	849.	716.	631.	536.	7360. 12/11/55
1957	2290.	1680.	1340.	1150.	789.	647.	509.	502.	3610. 12/09/56
1958	1510.	1100.	904.	709.	583.	499.	464.	417.	2250. 01/16/58
1959	3100.	2410.	1620.	1160.	928.	837.	730.	678.	4368. 11/20/58
1960	5560.	3000.	2030.	1420.	1110.	821.	609.	534.	9588. 12/15/59
1961	2990.	2110.	1340.	913.	772.	684.	583.	554.	4130. 02/21/61
1962	2670.	1720.	1480.	1130.	912.	665.	558.	463.	3920. 01/07/62
1963	2460.	1680.	1160.	756.	673.	517.	471.	431.	7030. 11/19/62
1964	4700.	2750.	1750.	1120.	880.	689.	620.	543.	4210. 12/25/67
1965	4700.	2750.	1750.	1120.	880.	689.	620.	543.	6540. 01/05/69
1966	4700.	2750.	1750.	1120.	880.	689.	620.	543.	2870. 10/01/69
1967	4700.	2750.	1750.	1120.	880.	689.	620.	543.	4580. 01/19/71
1968	4700.	2750.	1750.	1120.	880.	689.	620.	543.	5480. 11/04/71
1969	4700.	2750.	1750.	1120.	880.	689.	620.	543.	3310. 12/26/72
1970	4700.	2750.	1750.	1120.	880.	689.	620.	543.	3240. 01/24/74
1971	4700.	2750.	1750.	1120.	880.	689.	620.	543.	4720. 01/17/75
1972	4700.	2750.	1750.	1120.	880.	689.	620.	543.	6160. 12/02/75
1973	4700.	2750.	1750.	1120.	880.	689.	620.	543.	2790. 01/18/77
1974	4700.	2750.	1750.	1120.	880.	689.	620.	543.	5560. 12/02/77
1975	4700.	2750.	1750.	1120.	880.	689.	620.	543.	2490. 12/24/78

HIGHEST MEAN FLOW AND ANNUAL PEAK FLOW STATISTICS (YEARS 1953-1979)

	MEAN	MAXIMUM	MINIMUM	STANDARD DEVIATION	SKEWNESS	STD ERROR OF SKEWNESS	SERIAL CORR COEFF	COEFF OF VARIATION	MEAN LOGS	STD DEVIATION LOGS	SKEWNESS LOGS	STD ERR SKEWNESS LOGS	SER CORR COEFF LOGS	COEFF OF VAR LOGS	W R C ESTIMATE	SYSTEMATIC RECORD
	2960.4	5560.0	1510.0	1086.79	0.802	0.491	-0.062	0.366	3.445	0.156	0.121	0.491	-0.074	0.045	3.6517	3.6517
	1485.9	3470.0	1180.0	593.48	0.869	0.491	-0.054	0.366	3.281	0.125	0.064	0.491	-0.083	0.045	0.1597	0.1597
	1376.0	2160.0	984.0	337.08	0.630	0.491	-0.200	0.245	3.126	0.105	0.064	0.491	-0.244	0.034	0.0	-0.0300
	1053.9	1610.0	544.0	257.18	0.491	0.491	-0.371	0.256	2.914	0.110	0.096	0.491	-0.324	0.034	3.6517	3.6517
	844.5	1320.0	464.0	209.20	0.336	0.491	-0.256	0.248	2.829	0.110	0.096	0.491	-0.324	0.034	0.1597	0.1597
	689.2	998.0	409.0	147.04	0.155	0.491	-0.319	0.206	2.775	0.109	0.092	0.491	-0.303	0.032	0.0	-0.0300
	548.1	855.0	367.0	124.90	0.209	0.491	-0.300	0.197	2.731	0.108	0.086	0.491	-0.250	0.032	3.6517	3.6517
	492.3	746.0	344.0	107.86	0.165	0.491	-0.252	0.197	2.685	0.108	0.086	0.491	-0.210	0.031	0.1597	0.1597
	320.9	548.1	320.9	82.0	0.032	0.491	-0.210	0.197	2.639	0.107	0.085	0.491	-0.160	0.030	0.0	-0.0300
	306.4	548.1	306.4	82.0	0.032	0.491	-0.210	0.197	2.639	0.107	0.085	0.491	-0.160	0.030	3.6517	3.6517

HIGHEST MEAN FLOW AND ANNUAL PEAK FLOW EXCEEDENCE PROBABILITIES BASED ON LOG-PEARSON III ANALYSIS (YEARS 1953-1979)

	0.99	0.95	0.90	0.80	0.50	0.20	0.10	0.05	0.02	0.01
	1250.4	1567.8	1770.0	2058.4	2768.9	3762.6	4435.2	5301.9	5960.2	6624.8
	1041.0	1219.7	1333.8	1493.4	1801.2	2417.2	2778.0	3242.5	3945.5	4955.1
	770.7	902.6	982.8	1090.6	1334.5	1638.9	1827.5	2054.9	2217.9	2376.6
	501.7	581.9	641.9	724.3	830.1	948.0	1071.8	1243.7	1401.1	1670.2
	341.1	399.3	459.3	504.6	562.7	632.9	712.6	804.4	913.0	1059.1
	345.8	412.7	451.3	504.6	562.7	632.9	712.6	804.4	913.0	1059.1
	320.9	379.3	412.9	451.3	504.6	562.7	632.9	712.6	804.4	913.0
	306.4	352.0	379.3	412.9	451.3	504.6	562.7	632.9	712.6	804.4
	1906.5	2449.4	2799.5	3291.0	4484.6	6111.1	7184.0	8536.6	9582.9	10549.0
	1891.1	2441.8	2796.2	3291.0	4484.6	6111.1	7184.0	8536.6	9582.9	10549.0
	1906.5	2449.4	2799.5	3291.0	4484.6	6111.1	7184.0	8536.6	9582.9	10549.0
	1891.1	2441.8	2796.2	3291.0	4484.6	6111.1	7184.0	8536.6	9582.9	10549.0

STATION 12140000 SOUTH FORK TULI RIVER NW CAMPBELL, WASH.

HIGHEST MEAN FLOW IN CFS FOR THE FOLLOWING NUMBER OF CONSECUTIVE DAYS IN YEAR ENDING SEPT. 30

YEAR	1 DAY	3 DAYS	7 DAYS	15 DAYS	30 DAYS	60 DAYS	90 DAYS	120 DAYS	183 DAYS	ANNUAL PEAK-FLOW DATA FLOW (CFS) DATE MEQ. (IN)
1954										3100. 01/23/53
1955										3180. 12/09/53
1956										3230. 02/08/55
1957										5900. 12/11/55
1958										2290. 12/10/56
1959										1130. 01/17/58
1960										5000. 11/12/58
1961										6500. 12/15/59
1962										3420. 02/21/61
1963										2480. 01/07/62
1964										3260. 11/19/62
1965										996. 04/13/70 R
1966										902. 06/25/71 R
1967										973. 07/13/72 R
1968										708. 12/27/72 R
1969										772. 06/06/74 R
1970										688. 01/28/75 R
1971										752. 12/02/75 R
1972										515. 11/03/76 R
1973										1280. 12/02/77 R
1974										616. 03/08/79 R

HIGHEST MEAN FLOW AND ANNUAL PEAK FLOW STATISTICS (YEARS 1970-1979)

198

	MEAN	MAXIMUM	MINIMUM	STANDARD DEVIATION	SKEWNESS	STD ERROR OF SKEWNESS	SERIAL CORR COEFF	COEFF OF VARIATION	MEAN LOGS	STD DEVIATION LOGS	SKEWNESS LOGS	STD ERR SKEWNESS LOGS	SER CORR COEFF LOGS	COEFF OF VAR LOGS
	569.6	894.0	630.8	224.0	-1.017	0.687	-0.448	0.443	2.767	0.196	-1.503	0.687	-0.461	0.071
	512.1	710.0	436.5	690.0	576.0	123.0	225.78	180.97	128.01	107.88	85.86	66.24	0.432	0.336
	0.887	0.887	0.887	0.887	0.887	0.887	0.887	0.887	0.887	0.887	0.887	0.887	0.887	0.887
	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460	0.460
	2.767	2.767	2.767	2.767	2.767	2.767	2.767	2.767	2.767	2.767	2.767	2.767	2.767	2.767
	-1.503	-1.503	-1.503	-1.503	-1.503	-1.503	-1.503	-1.503	-1.503	-1.503	-1.503	-1.503	-1.503	-1.503
	0.687	0.687	0.687	0.687	0.687	0.687	0.687	0.687	0.687	0.687	0.687	0.687	0.687	0.687
	-0.461	-0.461	-0.461	-0.461	-0.461	-0.461	-0.461	-0.461	-0.461	-0.461	-0.461	-0.461	-0.461	-0.461
	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071

HIGHEST MEAN FLOW AND ANNUAL PEAK FLOW EXCEEDENCE PROBABILITIES BASED ON LOG-PEARSON III ANALYSIS (YEARS 1970-1979)

	0.99	0.95	0.90	0.80	0.50	0.20	0.10	0.05	0.02	0.01
	124.6	242.0	274.7	320.0	428.0	651.7	848.7	925.8	985.5	1030.4
	107.2	205.1	270.7	313.0	413.9	583.9	774.7	860.3	925.4	977.3
	70.2	147.3	206.7	256.2	339.8	461.4	590.8	696.8	784.8	858.8
	52.8	106.8	149.5	187.3	247.3	331.0	425.9	500.5	568.3	626.0
	45.7	87.6	121.2	151.2	197.2	252.6	310.4	368.8	420.4	468.9
	40.8	76.7	104.7	128.5	167.0	217.5	272.6	320.7	360.4	396.0
	37.6	68.3	92.6	113.7	143.5	181.7	225.6	268.5	303.1	332.1
	35.4	63.7	85.4	104.7	131.5	167.0	207.5	246.5	281.1	308.6
	40.1	72.7	100.7	124.5	157.0	194.5	235.6	274.5	308.6	335.4
	447.9	523.3	570.3	635.0	787.4	989.1	1120.2	1284.3	1406.0	1527.6

W R C
ESTIMATE

SYSTEMATIC
RECORD

TABLE 2.--Continued

STATION NUMBER	AREA (SQ-MI)	SLOPE (FT/MI)	LENGTH (MI)	ELEV (FT)	STORAGE (%)	LAKEAREA (%)	FOREST (%)	PRECIP (IN)	I2+I2 (IN)	SNOWFALL (IN)	JANMIN (FAHR)
12136000	10.36	472	6.5	2400	0.20	--	88.0	80.0	4.0	--	28.0
12136500	3.80	494	3.4	3670	0.60	--	52.0	85.0	4.2	--	28.0
12137500	74.50	80	19.2	3120	0.40	0.40	83.0	120.0	4.0	45	25.0
12138000	86.60	88	22.8	2670	1.27	--	98.0	148.0	5.0	--	26.0
12141000	56.40	40	15.1	625	2.11	2.11	91.0	48.0	3.0	15	31.0
12141300	144.00	117	29.6	3710	1.30	--	75.0	137.0	4.0	--	23.0
12141500	169.00	91	37.2	3500	1.30	1.30	74.0	132.0	3.5	335	23.0
12142000	64.00	85	17.3	3200	0.78	0.78	77.0	131.0	3.5	60	26.0
12142200	7.31	--	--	--	--	--	--	--	--	--	--
12142300	7.67	210	4.4	3380	13.80	--	76.0	65.0	2.5	--	29.0
12143000	95.70	68	24.2	3100	1.67	1.66	75.0	119.0	3.0	60	26.0
12143300	0.15	2800	1.1	2850	0.00	0.00	70.0	121.0	3.9	460	21.0
12143310	0.34	2530	1.4	3900	0.00	--	20.0	121.0	4.0	--	26.0
12143400	41.60	760	2.3	3390	0.31	--	80.0	120.0	4.0	--	22.0
12143500	45.80	--	--	--	--	--	--	--	--	--	--
12143700	1.57	--	--	--	--	--	--	--	--	--	--
12144000	81.70	102	27.2	2900	0.37	0.37	81.0	110.0	3.5	320	25.0
12144500	375.00	72	44.8	3300	1.23	1.23	76.0	118.0	3.0	240	25.0
12145000	32.20	--	--	--	--	--	--	--	--	--	--
12145500	30.60	179	12.5	1330	0.00	0.00	99.0	77.0	2.7	50	29.0
12146000	15.50	52	8.4	410	6.00	0.00	90.0	47.0	2.5	20	31.0
12147000	17.10	50	11.2	781	0.23	0.23	97.0	53.0	2.0	25	30.0
12147500	39.90	103	15.2	2590	3.00	3.00	73.0	97.0	3.5	25	28.0
12147600	5.34	225	3.9	3230	1.20	--	98.0	66.0	2.5	--	29.0
12148000	19.70	162	10.2	2940	7.11	7.11	59.0	112.0	5.0	35	27.0
12148100	2.19	610	4.1	2290	0.00	0.00	99.0	80.0	3.2	25	29.0